AN APPROACH FOR CADASTRAL RECORDS REORGANIZATION AND IMPLEMENTATION OF A TOPOLOGICALLY STRUCTURED CADASTRAL INFORMATION SYSTEM IN TANZANIA

By

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The government of Tanzania is in the process of changing the country's existing land policies in favor of a land market economy. In preparation for the anticipated increase in property conveyancing and land-related transactions, the government needed among other things, to:

- review procedures for recording land information and to adopt methods for strengthening administrative and cadastral capacity to support land registration functions;
- review the mission, organizational structure, and staffing allocation of regional offices, identify problems and institutional obstacles that prevent synergy of information handling and record handling among related agencies and the national registry.

- develop a well-designed administrative procedure for land registration as well as procedures for developing a cadastral information system suitable for Tanzania.

This dissertation presents a study of the organizational arrangements and administrative procedures for parcel allocation, parcel survey and demarcation, and the registration of all particulars affecting the creation of a legal cadastre in Tanzania. Administrative problems and bottlenecks that prevent the smooth flow of activities between the land management agencies were identified.

Approaches were developed to eliminate the land records organizational problems, improve administrative procedures for land allocation and title processing, and provide a streamlined method for faster document processing and land record maintenance. A land information system model was developed for Tanzania. The model uses topologically structured graphical overlays, to provide information support for a cadastral, cadastral information system. The graphical data are linked to the descriptive records through a newly developed parcel identification system for Tanzania.

Procedures were developed for isolating inconsistencies in the existing records which are in paper form and converting the error-free records into digital format. A procedure for adding new records to the computerized system and for maintaining the records up-to-date was developed.

A pilot project was initiated which successfully tested the topological approach for producing the cadastral index map to support a cadastral information system. The pilot study highlighted the ability to perform analysis on the data and to obtain information to support land management decisions, even in the absence of an accurately surveyed map.

CHAPTER 1
INTRODUCTION

An essential recipe for proper land management is up-to-date information concerning location, extent, ownership and use of parcels of land. In many developing countries, where a large percentage of the economy is tied to the land, land records are vital for efficient land and natural resource management. When maintained properly, such information can also help to facilitate transactions in land. In more developed countries with dynamic land market activities, information derived from land records offers substantial benefits to individual land owners as well as governments. For the individuals, currency of the information ensures, among other things, faster, safer and less cumbersome procedures for land-related transactions, protection of various rights to the use and enjoyment of the property, and fair taxation on properties. For the government, up-to-date and well maintained land-related information based on systematic recording of rights in land are important in many sectors of government such as physical planning of the land, revenue generation, infrastructure development, and environmental protection. Advances in computer technology and data management procedures have provided additional benefits such as the ability to perform complex statistical analysis on land records, identify trends in land market activities, and assess impacts of developments on

the society. The same cannot be said about synergy of land-related information in developing countries.

In 1974, a sub committee of the United Nations noted that,

> "...systematic records of land and rights in land have great importance for public administration, land planning, and land development, and private transactions in land. This situation is particularly true in those developing countries where the rapid growth of population has caused increasing pressure on rural land, while simultaneously a massive migration of people to the cities and towns has led to the uncontrolled growth of urban centers. Nevertheless, the need for accurate land records is often ignored by policy-makers; and the cadastral systems of many countries are, in consequence, highly defective..." (United Nations 1974, 25-26).

This situation resulted in improper planning and inefficient management of natural resources, and was a catalyst to exacerbated social and economic problems. This observation from the United Nations was probably the first to establish a link between accurate land records and efficient resource management. Reports from the World Bank (Feder and Davis 1991; Holstein 1990) indicate that although efforts have been made by governments of developing countries to improve the quality of their land records, progress has been slow and success stories are few.

Among developing African countries, the use of land as a source of livelihood often takes precedence over its use as a marketable commodity. In some rural communities of Africa, such as in Tanzania, Ethiopia, Zimbabwe, Uganda, Namibia, and Kenya, parcels of land have traditionally belonged to tribes, ethnic groups, or clans. Among rural communities, land titling and registration concepts, as are known and practiced in the western world, are alien to established systems of communal ownership and land stewardship. Common property rights in the traditional (indigenous) land tenure

system ensures that users hold land in trust for descendants of the community. In the urban centers of these same countries, despite the relatively active land-related transactions, many people view the processes of registration and titling as expensive, time consuming, and offer no tangible benefits to them as individuals (Moreno in Dale and McLaughlin, 1989, 27). The result is that only a small percentage of the land in most developing countries is registered.

The system for recording individual rights to the use and enjoyment of parcels of land in most developing countries function poorly. In the urban centers of most developing countries, it is financially costly and extremely time consuming to establish legal ownership to any land parcel, and to identify the type of limitations to the use of the parcel (Dunkerley 1985; Dale and McLaughlin 1989). Part of the economic problem in most developing countries has originated from improper allocation of land to its most economic use, improper or ineffective documentation of rights to land, and consequently, inability on the part of the government to monitor the use of the land and to invest in the resources of the land. In addition, most developing countries have not had proper procedures for recording transactions in land.

Experiences in developed countries indicate that private individuals, and the public as a whole, are benefitting from the derivative information which is obtained from large scale documentation of ownership and rights to land units. Such benefits are realized in terms of effective land management, fast and efficient transactions in land, fair property taxation system, and economic development.

Change, however, has begun to occur. Taylor (1991) noted that since 1986,

governments of many developing countries such as Mexico, Bolivia, St. Lucia, Zimbabwe, Botswana, Thailand, and Honduras, with the help of international agencies, such as the World Bank and the United Nations, have initiated programs to recompile and to maintain comprehensive records of land ownership as well as transactions in land as initial stages to effective land management. With the exception of Thailand, many of these programs are in progress and successful results with regard to effective land and resource management have not been well documented.

The research presented here is an effort to reorganize and modernize the land records management system in Tanzania in a manner that will enable the government to take control of land and resource management and to ensure economic development through proper land and resource management.

Research Objectives, Methodology and Scope

In 1991, the government of Tanzania initiated a reform of its existing land policy in favor of a land market economy. Adoption of a land market economy in Tanzania required that the cadastral system should not only be aimed at documenting the legal ownership of the parcel (as is the current situation), but it should contain information that may be used for faster property conveyancing, fair property valuation, equitable tax assessment and for monitoring land-related transactions and land use patterns. In reforming the cadastral recording system to accommodate the changes in objectives, the existing records and the recording process had to be purged of all the problems that prevented efficient land allocation and title registration. The improved recording system

had to be designed to facilitate the registration process, provide efficient data recording, storage, and retrieval methods, and where necessary, trace the sequence of land transfers over a specified period of time.

This research has been conducted using the following basic assumptions :

- Land as a resource, is essential to all mankind and therefore needs to be managed efficiently.
- The cadastre is a tool for land and resource management (Holstein 1990).
- The cost of compiling the cadastre should bear a direct relationship to the value of the land and the objectives for government (Dale 1990).
- A complete and up-to-date cadastral information system can serve as a resource for land management, and socioeconomic development and national development (Holstein 1990).
- The cadastre is the building block for a multi-purpose land information system (NRC 1983).
- The need to maintain land records is particularly important in developing countries (United Nations 1974; Dale and McLaughlin 1989).

The objectives of this research are:

- To investigate a suitable approach for reorganizing existing cadastral records by studying the existing process and identifying problematic areas.
- Identify and recommend actions that will eliminate the problems and pave the way for a more efficient cadastral data capturing and processing.

- Using the reorganized records, develop a cadastral information system which will be the building block for a broader Multipurpose Land Information System.
- Design an improved land data processing procedures to eliminate bottlenecks and to speed up the titling and registration precesses.
- Develop an approach for cleaning and updating existing records.
- Develop procedures for incorporating new data into the system.

To achieve these objectives, a comprehensive study of the Tanzania land delivery and cadastral record management system had to be done. The study involved visits to administrative centers within Tanzania to study the land management procedures. The study included, among other things, land allocation procedures, cadastral data capture and processing, title registration and records management procedures, as well as the legislation that identified the type, quality, standards, and format for the data. The record keeping and maintenance procedures had to be studied in order to identify problematic areas so as to develop improvements to the system.

The focus of this research is on organizational and administration issues pertaining to the reorganization of cadastral records and development of a cadastral information system for Tanzania. This research does not cover political, legal, policy or institutional issues pertaining to cadastral information systems, land management, or land information management in Tanzania, although it is recognized that these play a major role in land and resource management.

Definitions

For this research, "Land" is defined to encompasses all things directly attached to the surface of the earth, including those areas covered by water (Dale 1989). Land management is defined as the process by which land and resources in land are put to good effect. Land management includes resource management, which deals with facilitation of economic development through inventory, extraction, conservation, and sale of natural resources. Allocation and management of such resources are effected through instruments, concepts, measures, and principles which are based on culture, land laws, land tenure and property rights, registration of those rights, and transactions involving those rights (Holstein 1990).

Land administration involves the development and use of the land in the manner which has been prescribed by the instruments, land laws and property rights . The aim of land administration is to define management procedures, regulations and legal framework for agencies responsible for land delivery, estate management, revenue generation, planning and control of land resources. Land administration, therefore, provides the mechanism for land planning, parcel allocation, enforcing of rights and restrictions on the use of land, impact assessment and policy reform. These activities are facilitated by the ability to capture the relevant data to aid in monitoring and identifying areas where actions and reforms are needed, planning appropriate courses of action, implementing the adopted choice, and monitoring the results of the implementation for success and further improvement.

In this dissertation, information is defined as the product of data analysis. Within any organization, management decisions and actions arise from the flow of information upward, downward, and laterally across the organization. Due to the complex nature of decision making processes, vis-a-vis the external factors which influence the decision, quantity and quality of the available information upon which the decision is based, and possible impact on the organization and the community at large, there is often a need to establish an information system to support decision making processes. An information system is a group or pattern of associated activities which according to Anderson (1986), will normally have the following elements:

- A common purpose.
- An identifiable objective.
- An established sequence of procedures and data flow with at least one but possibly many elements of input, movement, action, storage and output.
- Feedback of information, giving control over the system.
- A boundary that defines the extent of the system.
- Dependence on specific data.

One such information system is a Land Information System (LIS). The purpose of an LIS is to provide a decision support for land management. In achieving this objective, the requisite data about the land, within the confines of the jurisdiction, are captured, stored, and processed. As an information system, an LIS has an established sequence of data input, data processing and output channels. For this dissertation, therefore, an LIS is

a system containing spatially referenced land data and requisite analytical tools for querying the data to obtain information to support land and related management decisions. The system may include human and technical resources which allow retrieval and dissemination of the information. At the root of land information systems are parcel-level, though not necessarily parcel-based, data.

A Cadastral Information System is a special type of land information system which deals specifically with cadastral data. It is comprised of computer hardware, software, and a database containing cadastral data such as the graphical layout of the parcel, ownership, size, location, use, and encumbrances that affect the use and enjoyment of the parcel. The system enables the performance of ad hoc queries on the data and may have graphical capabilities for the display of the results. Cadastral records play an important role when it comes to transactions in land and management of properties in the public and private sectors.

Due to marketability and transferability of land parcels, ownership information changes very often and hence consideration needs to be given as to how current this information needs to be to meet user needs. Information has to be relevant, available and timely, if they are to be of any use for land management. The purpose for which cadastral information are to be used should control the accuracy and reliability standards for data capture and management. Although in some circumstances one can be more important than the other, such relative importance could change over time.

Research Organization and Contribution

This research begins with the notion that land policy as an institution, governs all land management activities. From this standpoint, a land management taxonomy is developed in Chapter 2. The taxonomy identifies the hierarchical structure of land management and the role of information as a decision support tool in land management . Chapter 3 discusses existing cadastral information models and current issues pertaining to spatial, descriptive information and linkage mechanisms and reviews their focus and relevance to the Tanzanian objectives. Applicability of existing cadastral models to these objectives is discussed. This review helps to develop a cadastral information model which uniquely addresses the Tanzania land management problem. Chapter 4 takes an in-depth look at the existing land delivery system and cadastral arrangements in Tanzania and identifies inherent problems. Cadastral data capture and computerization methods are also reviewed with a view to remove bottlenecks. A discussion of the Tanzanian land delivery problems is conducted in Chapter 5. Solutions and approaches for eliminating the problems are discussed at this stage. A Multipurpose Land Information system which utilizes topologically structured graphical overlays is presented as a model for managing Tanzania land information. In Chapter 6, a pilot project aimed at implementing the recommendations and to highlight the benefits of integrated cadastral information system for Tanzania is discussed. Conclusions and recommendations are presented in Chapter 7.

This research makes an initial contribution to the field of cadastral record organization, with specific reference to Tanzania, by conducting an extensive study of the cadastral data capture, land allocation procedures, land registration system, and record

keeping and maintenance procedures in Tanzania. Organizational and technical problems associated with current practices and procedures are also identified. For the first time, the legislation identifying the structure and responsibilities of land management agencies within Tanzania are reconciled to identify areas of concern such as overlapping responsibilities and inconsistent authorities between land management agencies.

In developing procedures to alleviate the identified problems, a cadastral information model was conceptualized based on the information support system components which were developed in Chapter 2, using topologically structured graphical overlays for individual information support components. This approach which utilizes base maps in topological space is a deviation from existing models which are based on base maps in metric space. Some of the existing metric models have been reviewed in Chapter 3. In addition, the data organization is designed with regard to the type of land information support system (cadastral, infrastructure, socioeconomic, or environmental), rather than the agencies that utilize the information, especially since within any jurisdiction, the data requirements in terms of volume and accuracy, vary among agencies. Another contribution is the development of a hierarchical parcel identification structure based on the socio-political divisions in Tanzania and the public's perception of parcel identification, as a linkage mechanism between the descriptive information support systems and the graphical overlays.

In considering the records management aspect of this research, a systematic approach for reorganizing existing cadastral records, and developing a cadastral information system without drastically altering existing administrative procedures was the

objective. An approach for isolating inconsistent and obsolete data among existing records was developed. Another procedure for recording new information and for maintaining the integrity of the system was developed.

Finally, an approach for removing administrative bottlenecks within the system and speeding up the land allocation and registration processes without compromising accuracy or integrity of the data was developed. As would be observed, some of the contributions of this research are specific to Tanzania while other contributions, such as the topologically structured land information model and the parcel identification system may be applicable elsewhere.

CHAPTER 2
LAND MANAGEMENT AND CADASTRAL INFORMATION SYSTEM

Disregarding minor additions through volcanic activities, earthquakes, and other natural occurrences, land is finite in size. Land provides the resource base for most human existence. Humans, plants, and animals have always depended on the land for sustenance. As of yet, no substitute has been found to match the uniqueness of land both as a resource base and as the platform upon which terrestrial activities are performed.

People have different concepts or attitudes about land. On one extreme land is viewed as property which carries specific rights of ownership and use which is transferable to other people. This concept is dominant in developed countries where land is viewed as a marketable commodity and, as such, can be used as collateral for credit and economic development (Marquis 1979).

Another extreme is the view of land as common property. This view implies that rights of access and use of the land belong to members within a specific group or community. Access and use by people outside of the group or community is restricted (Bohannan 1973; Marquis 1979). This concept is mostly held in developing countries where land is viewed as an interacting natural system whose integrity needs to be protected, an whose primary qualities have to be preserved for future generations (Andrews 1979).

Population increase, large scale mechanized farming, and urbanization have imposed unanticipated pressures on the available land in both developed and developing countries. For example in Tanzania, mechanized farming during "operation vijiji" (see Appendix B) eliminated large portions of the breeding grounds of the Masai tribe and introduced other socioeconomic problems besides alienation of their land. With advancement of development and agriculture, industry and settlement compete for available land. Usage of parcels of land undergoes changes, sizes of holdings change, and land values change in response to social and economic factors. Land management activities such as land use planning and control are therefore critical to the survival of any nation or community that is undergoing development to ensure that any piece of land is put to its most economic use. In this chapter, the role of information in decision-making is reviewed in the context of land management. This chapter establishes the need to organize land records in a manner which facilitates synergy of information in support of land management decisions.

Land Management

Land management, in the context of this research, is viewed as an embodiment of legal principles, administrative procedures, and operations which are associated with the stewardship of land. The overriding principle for land management activities is the policy (see Figure 2-1). Land policy is an institution which comprises of social, economic, cultural, and legal prescriptions that define how the land and benefits from the land are to be allocated, and the manner in which the land and resources are to be used (Dale and

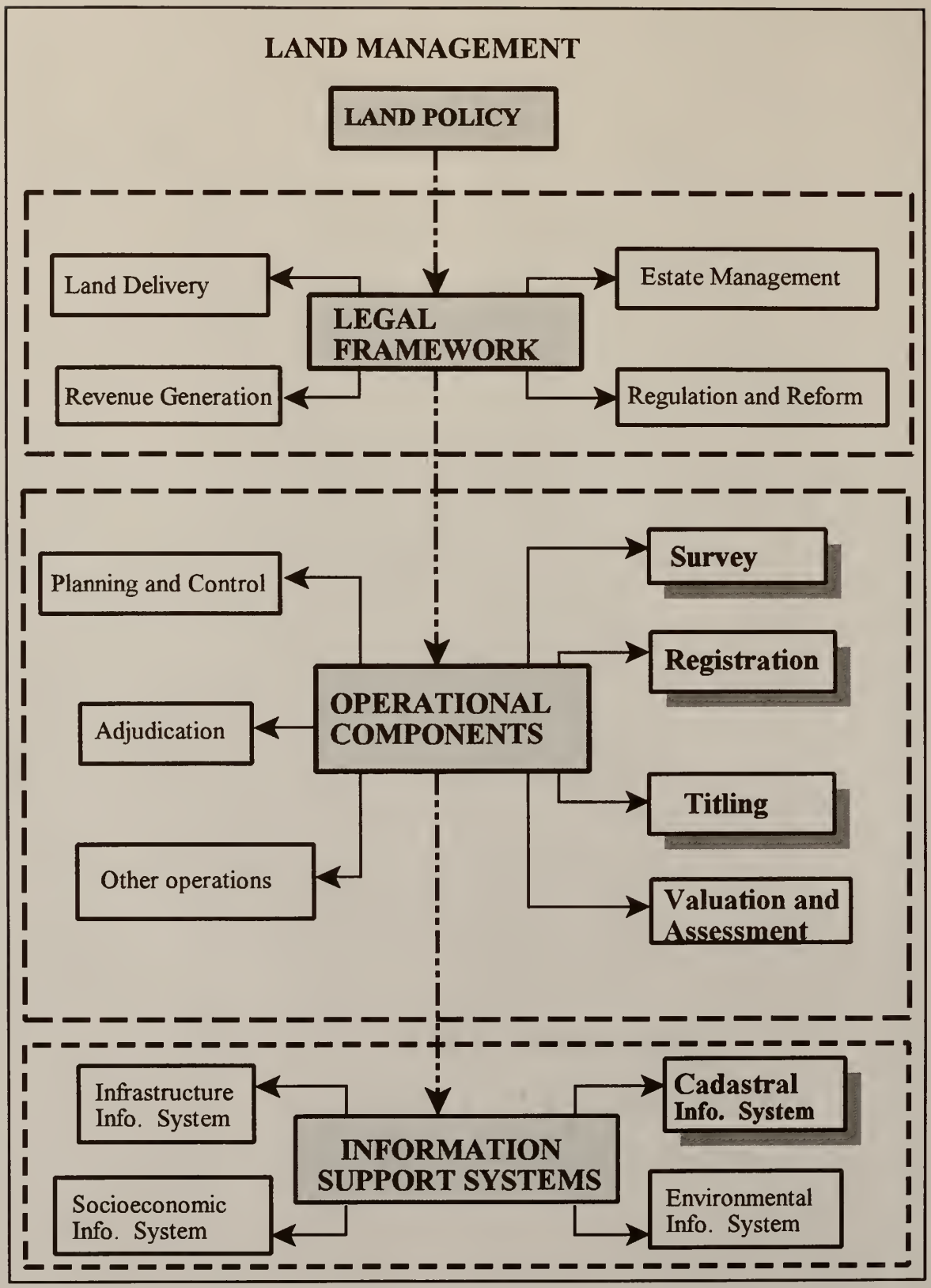


Figure 2-1: Land Management and Land Information Systems

McLaughlin 1989, 6). A land policy provides the guiding framework within which interests in land may be held and the manner in which the land, as a resource, may be managed.

Barnes (1994a), contends that in the ideal situation, the land policy should reflect the practices of the people, even though this is not the situation in many developing countries. Land policy prescriptions are defined through instruments, land laws, rules and regulations which are executed by land administrators. Although the policy should establish the legal framework within which land management operations are conducted, it has been noted by Barnes (1994b) that in many Latin American countries the land laws are drafted with little or no regard to the indigenous tenure practices of the people. Another example is Tanzania, where existing land laws are the same as those that were enacted by the colonial governments, with minor modifications such as replacing the word "Governor" with "President." Existing land policies of Tanzania clearly do not reflect the land tenure practices of the Tanzanian people (Shivji 1995, 4-8). The legal framework of land management is the subject of the next section.

Legal Framework

Through the legal framework of land management (Figure 2-1), rights and rules which guide the development and use of the land in accordance with the prescriptions of the land policy are established. The objective of the legal framework is to define guidelines for managing land resources, protecting individual rights to the use and enjoyment of the land, consolidating land, protecting the environment, and controlling land

development and land degradation, which may result from uncontrolled urban migration, excessive use of chemicals, pollutants, and other adverse uses of the land.

The legal framework defines the mechanism for land planning, parcel allocation, enforcing of rights and restrictions on the use of land, impact assessment, and policy reform. 'Rights,' in this context, should be distinguished from 'rules' governing the use of the land or its resources. The Random House Dictionary of the English Language (1971) describes a 'right' as a just claim, whether legal, prescriptive or moral, and defines 'rules' as principle or regulation governing a conduct, action, or procedure. Rules, therefore create regulations and thereby, authorizations. A property right is the authority to undertake particular actions related to specific domain on the land. For every right an individual holds, rules exist that authorize or require particular actions in exercising that property right. In addition, all rights have complementary duties. To possess a right implies that someone else has a commensurate duty to observe this right. Thus, rules specify rights and duties.

Proper land management cannot be achieved by simply defining the legal framework to guide the manner in which resources pertaining to land can be used, but also by providing suitable conditions for individual social and economic development, such as secure ownership, access to credit facilities, and participation in land markets transactions (Holstein 1990; Palmer 1996). Legal prescriptions of land management are defined with relevance to issues pertaining to land delivery, estate management, revenue generation, and regulation and reform (Dale and McLaughlin 1989; Nichols 1993). These are described in the subsection below.

Land Delivery

This involves acquisition of land for public good or public use, government projects, and new settlements particularly to accommodate the poor and landless, and the assignment or delegation of interests in land parcels to individuals and organizations. An ideal land delivery system should enable planned access to land in order to meet basic and developmental needs of the people (Williamson 1990, 88). Land delivery procedures vary from country to country. However, national interests and patriotic behavior requires that those who have access to land, use it productively, and in a manner that will enhance national development.

In Tanzania, where the land is regarded as belonging to the state, and land ownership in perpetuity is not the practice, rights to the use and enjoyment must first be obtained from the state. Allocation is normally for a fixed period with some reversionary rights and some usufructuary conditions. There may be conditions attached to the use and enjoyment of the land so as to ensure enhancement and proper use. One such condition may be that the land must be used for a specific purpose, such as agriculture, residential, or commercial. Another condition may be that the land should be developed within a specified period of time to avoid forfeiture.

Estate Management

Estate management involves the management of large land holdings owned by organizations and communities, such as tribes, clans, and families. In some jurisdictions, the rules of land management within an estate may differ from those of other lands within

the state. For example, in Tanzania, it is required that individual owners of urban land should have registered titles whereas an individual title is not required for property ownership within community land. Another example is the situation whereby parcels in an urban setting may be transferred to anyone, whereas community land may only be transferred to members of the community. In villages and rural areas, where the land is owned by the community, a 'Right of Occupancy' title is issued to the communities.

Regulation and Reform

Regulation and reform deals with issues affecting the manner in which land and its resources are used. In developed countries, regulations in land use are imposed not only to protect the land from excessive degradation and abuse, but also to protect the public and the environment. As development progresses and priorities regarding the demand for available land change, the need arises to review the uses for particular pieces of land and to reform policies and conditions affecting certain uses of the land. Regulation and reform activities are designed to monitor the land and to recognize changing objectives so as to reform the land use plans, and to control excessiveness accordingly.

Revenue Generation

The revenue generation function is a way for the government to generate revenue for land and infrastructure development. In developing countries, this is done in the form of fees for processing transactions in land, such as sales, transfers, and registrations. In situations where the land has been leased for a fixed term, a rental fee may also be imposed.

In some developed countries, such as the United States where the full bundle of rights is conveyed during a sale or transfer, one of the methods for generating revenue from land is to impose a tax on structural improvements which have been made on the land.

The legal framework of land management is implemented through operational agencies which are responsible for adjudication, planning and control, land survey, registration and titling, and valuation and assessment (see Figure 2-1). These are discussed in the next section.

Operational Agencies

Operational agencies constitute the organizational arrangements which are made to administer the prescriptions within the legal framework to support land management activities. Operational agencies consist of divisions in management that are staffed by personnel whose responsibilities include the provision of services in accordance with the legal interpretation of the guiding principles of the land policy. The operational component of land management is multi-disciplinary. Effective land management involves the interaction and coordination of several government agencies and several operational units.

There is no definite pattern as to which agencies should be responsible for any particular operation. However, for this research, land management operations have been defined to include land use planning and control, adjudication, land survey, titling, registration, and valuation and assessment (see Figure 2-1).

Those with decision-making responsibilities within these agencies are constantly having to review their plans and actions, and to modify decisions in accordance with

changing conditions. Such decision makers need the information that may be derived from analyzing the database, in order to make sound decisions. Decision-making within the operational components are either to provide solutions to prevailing or impending problems, or to capitalize on opportunities.

Problem detection and resolution arises when prevailing conditions indicate a deviation from the expected results and therefore may impact adversely on expected objectives. For example, if the data indicate a higher than normal growth in urban population, the decision may be to allocate more land for residential purposes. This decision may be an ad hoc one, however, a closer look at the data may reveal some underlying cause, which may require a more permanent solution. Timely resolution of such a problem can avoid some of the socioeconomic problems that are associated with excessive urban migration.

Opportunity-seeking on the other hand, arises when the facts suggest that a particular action may result in opportunities for the agency or the community. For example, the strategic decision to construct a dam across a river may be aimed at providing more agricultural land, jobs and development for the community. Also a decision to computerize land records based on the knowledge that the information would be useful as decision support resource for efficient land management operations. Both problem detection and resolution, and opportunity-seeking strategies are based, not upon instincts and wisdom alone, but on analysis of available data, together with external factors, such as socioeconomic and environmental conditions within which the agency operates (McCloy 1995, 342-347).

Planning and control, in the context of land management deals with allocation and monitoring of resources in land with a view to maximizing efficiency by putting land to its best use while ensuring the welfare of the community and the sustainability of the available resources.

Adjudication is the determination of rights in parcels of land. The procedure involves identification of the types of rights in the land, the persons in whom those rights are vested, and limitations to the enjoyment of those rights. The adjudication process is used by the operational units to eliminate defects in land titles by judiciously applying the legal principles that define land ownership (Dale and McLaughlin 1989).

Due to the broad scope of land management activities, the following section is focused on the cadastral aspect of land management operations, which involves land survey, land titling and registration, and in the case of fiscal cadastre, valuation and assessment.

Land Survey

Land survey is a process for providing the geometric framework for mathematically defining land parcels. As an essential land management tool, survey plans and maps are used for planning and controlling development, for redefining disputed and uncertain boundaries, and for defining property, political and geographic boundaries. Different types of land survey activities are conducted for different purposes. For example, cadastral (land inventory) surveys are used to establish property boundaries and to determine sizes and

shapes of the parcels over which individual rights exist. Cadastral survey of the mutually accepted boundaries ensures that the boundaries can be replaced if they are destroyed.

Wherever possible, cadastral surveys should be tied to a network of pre-established control points which were connected to a geodetic reference frame. The global positioning system (GPS) and advances in modern surveying technologies have made it easier to connect more survey works to the geodetic reference framework. With advancement of computerized information management systems, survey plans and maps, in electronic forms, have become an integral part of a land information system (LIS). These approaches facilitate the integration of information because it is referenced to some spatial reference framework.

Land Titling

Land titling is the process of issuing valid property titles by a recognized state agency to existing occupiers of the land who do not have legitimate titles. The land titling process confers official recognition of individual rights to the use of any particular parcel. In a title registration system, such as the Torren's system in Australia, where some guarantees are offered by the state against inadvertent loss due to an error in the registration process, the title provides the unimpeachable proof of ownership and therefore tenure security (Dale and McLaughlin 1989, 26) to the individual. Land title records constitute a step towards land records compilation for the government. As documentary evidence of ownership, the title may show types and limitations of any rights that are exercised over the particular parcel of land. There is a general belief that secure property

rights, in the form of registered titles, act as an inducement for investment in real property and, in the longer term, contribute to increased productivity by the individual (Holstein 1990; Lemel 1985). Feder, et al. (1988) also have presented evidence to support the notion that increased security of tenure by having title documents increased agricultural productivity in Thailand by between 11 and 27 percent over comparable non-secure properties. Land titling should be accompanied by a registration system in order to legalize the ownership of the property.

Land Registration

Land registration is the process of recording information about legal claims to parcels of land. Registration is done to ensure clear and unambiguous titles and to avoid fraud and disputes pertaining to conflicting claims concerning the right of use and enjoyment of any piece of property. The types of registration include :

- private conveyancing whereby the records of the transaction are handled privately between the individual parties, sometimes in the presence of witnesses.
- the deed system where the copies of the transaction records are kept in an official registry of the government or state.
- title registration in which a state organization maintains the records, sometimes with some guarantees in terms of security.

In the past, most forms of land registration were classified as either deed registration or title registration. Over the years, adaptations of the two systems have been implemented by governments according to their objectives and suitability of the system to their local

purposes. The main differences between deed and title registration systems have been documented extensively (Dowson and Sheppard 1968; Simpson 1984; Dale 1990; Larsson 1991). Since the focus of this dissertation is more on the land records and the precess for acquiring such data than on the legal and institutional aspects of land registration systems, this distinction will be ignored. However, it is important to note that as a land management process, the system of land registration can influence not only the physical and legal, but also the social and economic environments (Dale and McLaughlin 1989) of any jurisdiction.

Valuation and Assessment

In order to generate revenue for development, procedures are adopted to assess and to tax land as a resource. Property rating and assessment are two methods that governments use for generating revenue from land for development (Dale and McLaughlin 1989, 47). With the property rating system, revenue is generated as a result of a property assessment. The tax is applied to improvements to buildings, and other structures that have been erected on the land, and the uses to which the structures are being put. With land valuation, tax is determined not on the structure that have been erected on the land nor on the land use, but on the basis of the value of the land itself as determined from the improved or unimproved state. The revenue generation objective necessitates classification of the uses of land parcels, and where necessary, the yield. This ensures a fair assessment of tax liability. Land records for such purposes have been an integral component of the original 'cadastre'.

Cadastre. The word cadastre has its origins in antiquity when it referred to a register containing descriptions of land parcels, value, use and proprietorship. The original purpose for cadastral records was to assess the liability for tax and to determine responsibility for payment. Over time, the records began to show evidence of land rights (Simpson, 1984). Dowson and Sheppard (1968, 47), remarked that:

> "... it is impossible to give a definition of cadastre which is both terse and comprehensive, but its distinctive character is readily recognized and may be expressed as the marriage of :
> 1. A technical record of the parcellation of the land through any given territory, usually represented on plans of suitable scale, with
> 2. Authoritative documentary record, whether of a fiscal or proprietary nature or of the two combined, usually embodied in appropriate associated registers...."

Today, the term cadastre is used to imply a parcel-based up-to date record of rights, and responsibilities in land (FIG 1996).

The cadastral record includes a graphical delineation of the land, to which other descriptive records pertaining to ownership, types of rights, and sometimes the value of the parcel and any record of improvements on the land are linked. Such pieces of data are contained in the land survey, land registration, and the valuation and assessment records, as shown in Figure 2-2. The use of cadastre has broadened to an extent that in situations where standards for its creation and maintenance can be ascertained in the judicial system, the cadastral record may have legal status which is recognized by the courts, not only as property description, but also for confirming right of use to the registered owner (Larsson 1991). The cadastral map can also serve as an index to other legal records such as mortgages and liens. Currently, there are three distinct types of cadastral records (Simpson

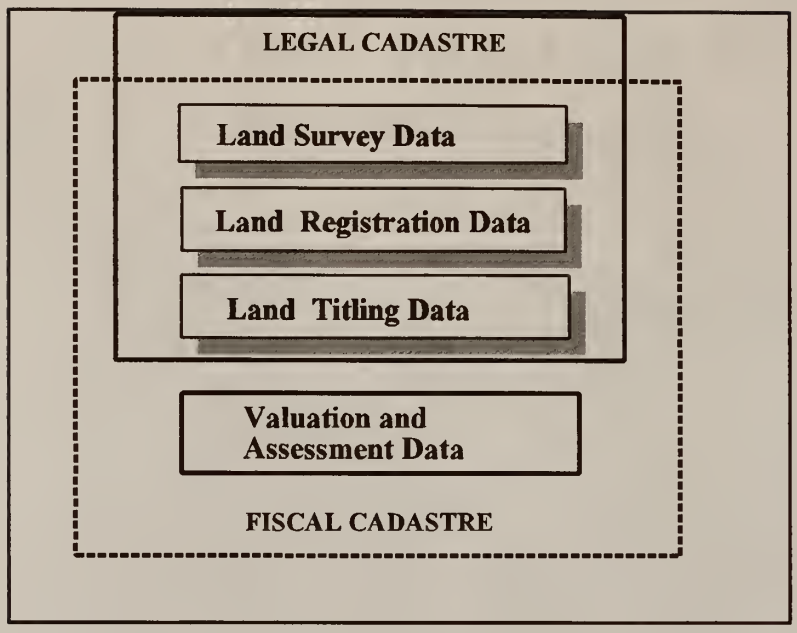


Figure 2-2: Components of a cadastre

1984; Dale and McLaughlin 1989);

1. Fiscal cadastre which refers to a register that has been compiled primarily for property valuation and tax assessment as a source of revenue generation for the government. As an information resource, it also serves as an instrument for administering the policy on land taxation system. It provides the information base for equitable and efficient tax assessment.
2. Juridical or legal cadastre which contains records of the legally recognized record of land ownership as a means of avoiding conflicting claims to the use and enjoyment of the parcel of land. It also provides a means for legally transferring those rights or interests, either through sale, lease, or mortgage. As an information resource, legal cadastres provide the information base on land ownership to assist planners in their efforts to sustain development and curtail abuse of the land.

3. Multipurpose cadastre is a combination of both the fiscal and the juridical as well as other parcel-related information. It provides a variety of land tenure, registration, and information services that are required by the community and other land management agencies (McLaughlin 1975).

While the origins of cadastral record compilation may be tied to tax collection of the olden days, principles underlying the cadastral register have been adopted around the world due to the amount of information that can be derived from an analysis of the records.

The operational components of land management involve decision-making as well as selection of choices among possible options. The availability of information in an appropriate form can reduce the amount of uncertainty among the options. For efficient performance, therefore, operational agencies require an information support system in order to make sound land management decisions. Information support systems are discussed in the next section.

Information Support Systems

Information is the basic ingredient for sound decisions. In a decision-making situation, data alone can be overwhelming. Within any organization, better information leads to a better understanding of a situation, and thereby, the possibility of a better management decision. The need for a timely and informed decision calls for innovative ways to not only access accurate and up-to-date information, but the tools to analyze the available data and present the information in useful and easily comprehensible ways.

Activities within the operational units of land management in Figure 2-1 can be viewed as a series of decision making processes. Information pertaining to the land are needed to support decisions concerning the operational aspects of land management. Through decision-making processes, rights, restrictions, and uses of the land are continually revised so as to sustain development and maintain the maximum utility of the land. For example, the rights and restrictions applied to peri-urban land in a developing country may change once the area is integrated into the urban town. Administrative control is transferred from the community to central or district government. Different rules and regulations are applied to the transfer, sale, and use of what used to be village or community land. Similarly, the use of a particular piece of land may change from residential to commercial in order to keep pace with development and to satisfy the need to provide amenities for the residents. Land managers need adequate information pertaining to the land for planning, managing, and controlling its resources.

Many of the developing countries that maintain cadastres still use rudimentary filing systems. With population increases and an associated upsurge in demand for land and parcel-related transactions, there is an increased need for more refined information to support decisions in land management. These situations call for a need to record details of land parcels in an organized manner. Depending on the number of files, volume of information, methods for cataloguing, and storage of files, information retrieval can be an onerous task. In most developing countries, the inadequacies of information pertaining to the land pose serious constraints on land administration and resource management. Without knowledge about the land ownership and type of tenure, development programs

are difficult to initiate. Land-related information which is embodied in the cadastre, is being increasingly recognized by governments as valuable resource for decision-making in land management (Dale 1991).

Governments of many developing countries are reorganizing their cadastral records so as to derive the benefits of effective land administration. The governments are doing this by ensuring that rights in land are identified, recognized by the state, and are recorded in a suitable form. Examples of such activities are found in Peru (Palmer 1996), Bolivia (World Bank 1995), and Asia (Burns et al. 1996). Land records are also being converted into digital format so as to harness the benefits of technological advances in data management and information processing with the use of computers.

Advances in computer technology during the latter part of the 20th century have contributed immensely to the growth in the use of information handling technology. This technology has offered decision makers the tools to adequately analyze voluminous amounts of available data and the ability to model the effect of decisions, even before they are implemented. This opportunity provides a means to perform ad hoc queries in order to arrive at a viable option when it comes to decision making and allocation of resources.

In Figure 2-1, the information support system in land management has been grouped into four broad categories: environmental, socio-economic, infrastructure, and cadastral (Dale and McLaughlin 1989, 11). Each group can serve as an independent land information system.

Environmental Information System

The focus of an environmental information system is to provide information about factors which influence human health as well as ecological and economic impacts of land use. The objective of the system is to protect and improve air quality as well as land and water resources from degradation and abuse.

Human activities are not the only the only factors that can adversely affect the quantity and quality of the resources. Naturally occurring phenomena such as volcanoes, earthquakes, tornadoes, hurricanes and forest fires are all factors which impact the environment and hence human survival. Therefore, an environmental information system is used to address issues associated with human activities and programs that affect the environment at local, regional, or global levels. Examples of environmental issues would be wetland depletion due to rapid and unplanned development, impact of development on endangered species and degradation of the ecological system, flood analysis, and pollution control.

Socioeconomic Information System

Socioeconomic information systems include census, demographic, and statistical data which are essential to government agencies for planning. Several different types of data are gathered during a population census which are used by governments to monitor progress of development and to plan for the future. The information derived from the data helps to redefine priorities with regards to development objectives and to re-allocate resources with respect to amenities such as schools, housing, infrastructure, and other

needs. By themselves, socioeconomic data may not qualify as land information. However, when demographic data are referenced to a spatial location, the data become land-related and therefore could be used as an input into a land information system.

Infrastructure Information System

Also referred to as Automated Mapping and Facilities Management (AM/FM), an infrastructure information system is used for managing engineering and utility structures such as pipe lines, telecommunications, transportation, and underground facilities. In general, utility companies have the same requirement as parcel-based record keeping to maintain records of their transmission and distribution networks, and to make decisions regarding system capacities to meet public demand based on growth potential. With a infrastructure information system, it is possible to forecast demand for utilities, plan extension, locate plants for maintenance, and provide service connections. Land Managers, in turn, benefit from such an information system by obtaining up-to-date information on the development of the land so as to strategically plan for the location and magnitude of future facilities.

Cadastral Information Systems

Information pertaining to land parcels and land ownership and use are always needed by several agencies for land management purposes. Reliable land records on their own, do not provide solutions to land management problems. However, they do provide the resource through which solutions can be devised and implemented. Whether the

cadastral records are kept in a manual filing system or in a computerized format, a cadastral information system provides the government and other interested parties with a complete and up-to-date inventory of land holdings and land use patterns for a particular jurisdiction. A cadastral information system, as illustrated in Figure 2-3, is a system comprised of computer hardware, software, database, and human resource, which operates on cadastral data.

The cadastral data may vary in accordance with the goals of the cadastre. Whereas a legal cadastre will have information about the legal description of individual parcels, the fiscal cadastre will contain such information as land value, land use, and tax liability. Other information such as ownership, shape, area, location, and owner's address may be common to both fiscal and legal cadastres. The system may be linked to other records such as data at the land registry or utility records. The records are compiled from affidavits, signed or notarized documents, maps, documented evidence, boundary identifiers, adjudication records, files, and other legal documents that contain relevant information about the parcel. In a dynamic land market, cadastral information is the most clearly documented type of land information because ownership of properties changes every so often. Proper records maintenance and updating procedures must be adopted in order to keep the data current. A computerized cadastral information system allows analysis and synergy of information in support of land management activities.

Grouped together, information support systems as shown in Figure 2-1, are referred to as a Multipurpose Land Information System (MPLIS). Multipurpose land information systems are recognized as a valuable resource for effective decision making in land

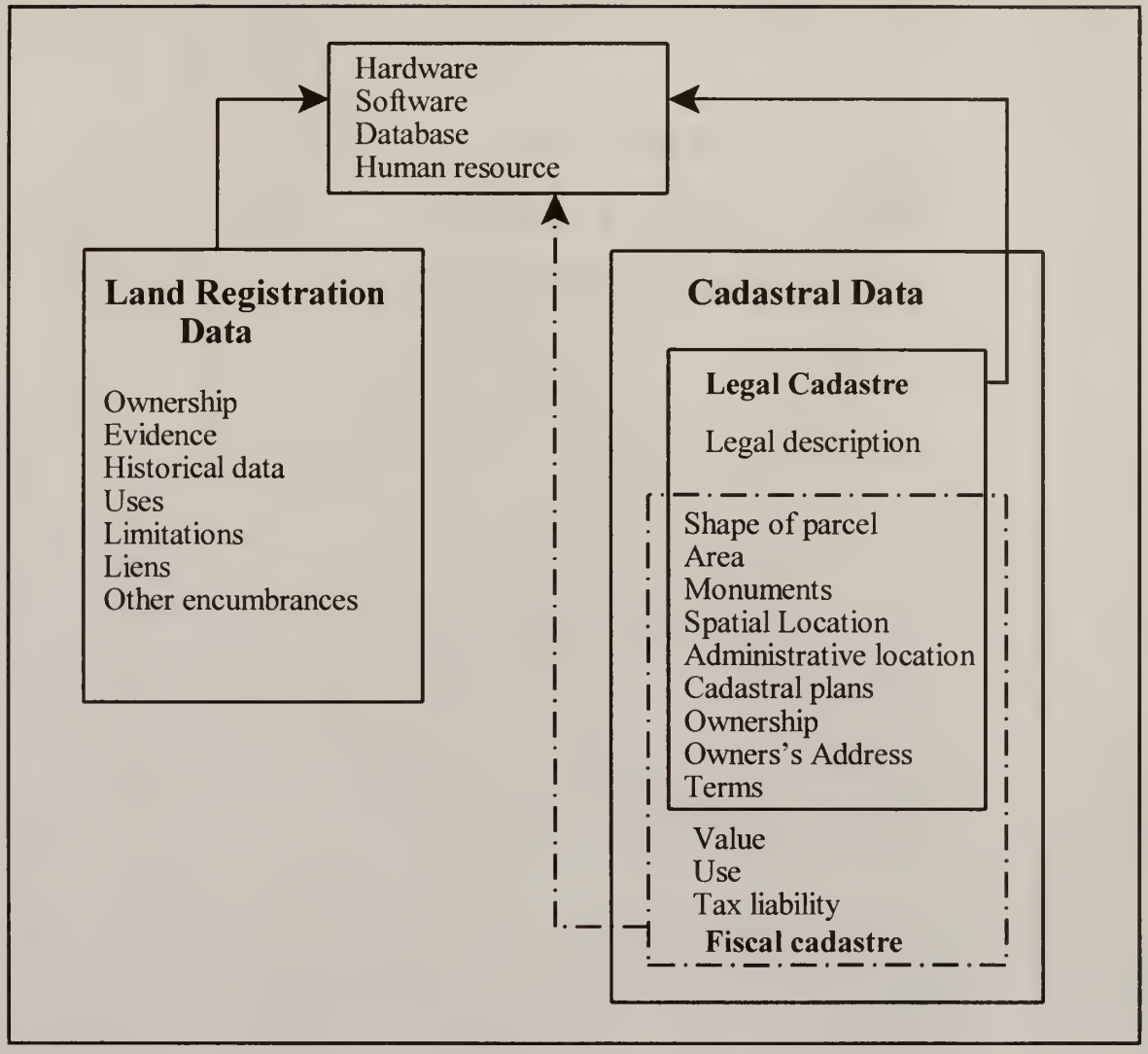


Figure 2-3 Components of a Cadastral Information System

management (Dale 1991). In most developing countries the inadequacies of information pertaining to the land pose serious constraints on land administration and resource management. Since 1985, emphasis in many countries has been placed on ensuring that rights in land are identified, recognized by the state, and are recorded in a suitable form. Examples of such activities are found in Peru (McLaughlin and De Soto 1994), Bolivia

(Barnes 1994a; Barnes 1994b), Asia (Burns et al,1996; Feder and Nishio 1996), and the Republic of Belarus (Bloch 1996). Such activities involve graphical delineation of the property boundaries followed by an association of the relevant descriptive information. Several approaches have been adopted to produce a representation of the property boundaries. The approaches range from rudimentary land survey methods, such as the use of the surveyor's compass and linen tape, to photogrammetric methods with variations dictated by circumstances such as cost, time and technology. The next chapter deals with current issues relating to graphical data capture and attribute data compilation.

CHAPTER 3
CADASTRAL INFORMATION AND RELATED ISSUES

Advances in computer and information technology have revolutionized the way management decisions are made. Information systems are being utilized as decision support resources to minimize the uncertainty in the choices that are made by management. With cadastral information, technology is again impacting the method for capturing the graphical data, the structure of the descriptive data, and organization of the cadastral records so as to meet the information requirements of the jurisdiction. Current research has focused largely on three distinct areas of the cadastral information system. These are the structure of the cadastral model, the methods used to capture the graphical data, and the organization and association of the descriptive data. This chapter deals with a literature review and identifies current thinking in these areas, even though the state of technology in Tanzania does not lend itself very well to the application of the latest technology.

Historically, land records have been compiled for public use, by the State or by the private sector. Simpson (1984, 124) distinguishes between land records which have been compiled for the benefit of the State and those that are compiled by private entrepreneurs. Whereas information required by the private sector are those which facilitate dealings in land such as conveyancing and mortgage, those that are required by the state are related to issues such as taxation, economic planning and land management.

A cadastral information system, as has been shown in Figure 2-1, is a type of land information systems which is central to the land management process in any jurisdiction. Development of cadastral information systems in the developed world have been influenced by factors such as technological advances in the latter part of the 20th century, the need for improved methods of managing land and related resources, and efforts to protect the environment. In recent years, the type and detail of cadastral information that is needed to support particular societal and administrative needs have been changing with respect to the changing needs of the society. In the 1980s, researchers focused on cadastral models to identify the complex interactions between the cadastral information and institutional, political, and economic development of governments. Later, Williamson (1990, 81) observed that cadastral models and related studies which evolved in the 1980s clarified concepts, identified essential elements and broadened the use of cadastral information. A description of the different types of cadastres is presented in the next section.

Different Types of Cadastres

Today, many types of cadastral systems are in operation with varying degrees of resemblance to the classical fiscal and legal cadastres. Distinguishing characteristics of cadastral information systems include factors such as the spatial resolution and scale of the source map, the type and characteristics of the information that are recorded, and the professional responsibility for managing the data. The Féderation Internationale des Géomètres (FIG) (1996, 3) has identified the following means of categorizing cadastres:

- their primary function. (e.g. tax, juridical or multi-purpose land management).

- the type of rights that are recorded. (e.g. sub-surface rights, mineral leases, or private ownership, timber concessions, etc.).
- the level of state responsibility in ensuring the accuracy and reliability of the data. (For example, some cadastres may have complete state oversight and responsibility and perhaps state guarantee of tenure security whiles other systems may be implemented with varying levels of public and private sector responsibilities for data and information management).
- location and jurisdiction. (Distinguishes between urban and rural cadastres as well as centralized and decentralized cadastres).
- the way in which information about the parcel are collected. (Methods for capturing cadastral information include digitizing from existing maps and plans, aerial photogrammetry, ground surveys tied to a geodetic reference framework, uncoordinated ground surveys and measurements, cadastral survey using Global Positioning (GPS) methods, geo-referenced aerial photography, etc. Each method contains a certain degree of positional accuracy which influences the spatial resolution of the system).

Cadastral information systems are regarded as vehicles for economic growth and social equity (see Palmer 1996; Holstein 1990; Holstein 1996). In consonance with the modern concept of information synergism, funding agencies such as the World Bank, the United Nations(UN), International Development Bank (IDB), and the United States Agency for International Development (USAID) are working with governments of developing countries to reform their cadastral systems and to modernize their land records. Cadastral

information models have been developed based on needs and priorities. Below are reviews of some of the existing cadastral information models.

Existing Cadastral Information Models

Perhaps the earliest attempt to establish some connection between the information provided by the central components of the cadastre and information required by the government for socioeconomic development and land management was presented by Dale (1976) in the United Kingdom and McLaughlin (1975) in Canada. Dale presented a cadastral model that was comprised of central process elements which were influenced by external factors. The external factors consisted of a broad spectrum of factors ranging from government, education and professionalism, to legal issues and socioeconomic factors. The central processes consisted of adjudication, demarcation, survey specifications, survey methods and boundary description. The central processes were linked by output elements and some feedback mechanisms. The output elements being the cadastral map, title records, valuation and taxation, and planning and control elements. The feedback elements for the model were the title legislation, land values, planning and control, and boundary disputes.

An interesting point about Dale's model was the fact that the boundary descriptions served as the linkage mechanisms to the output elements. The key elements of the entire model were the land survey and the boundary definition. It is not clear at this point whether the model depicted a bias towards Dale's profession as a surveyor, but it is obvious that at the time of its inception, the dominant factors regarding the cadastral

process were the boundary definition rather than land use or the resources within the boundary. Other than simplified keywords, the use of long and verbose boundary description as a linkage mechanism in a computerized environment would have presented some coding problems, both in the amount of space required to store the code and the processing time when it came to searching for an item. More importantly, since people use different words and style in describing the same parcel, the descriptions of a boundary could differs from one database to another. Dale's model did not envisage multipurpose land information systems. McLaughlin (1975) presented the role of the cadastre within a multipurpose land information management system and identified cadastral information as a land management tool and a decision support resource. This became the cornerstone for the cadastral models that are currently in existence.

The North American Model (NRC model)

McLaughlin's presentation was followed by a multipurpose cadastre model which was developed by the National Research Council (NRC) in 1983 as a basis for a multipurpose land information system for North America (see Figure 3-1). The model is conceptualized as an integrated land information system for both administrative and public uses. It was developed in response to growing concerns about how foreign land ownership affects the balance of trade in the United States, land prices, access to farm land by young farmers, intensity of land use, and community viability (NRC 1980, 12-13). The primary objective was for land administrators to provide public administrators such as governors, mayors, as well as Congress with information pertaining to land holdings, distribution and

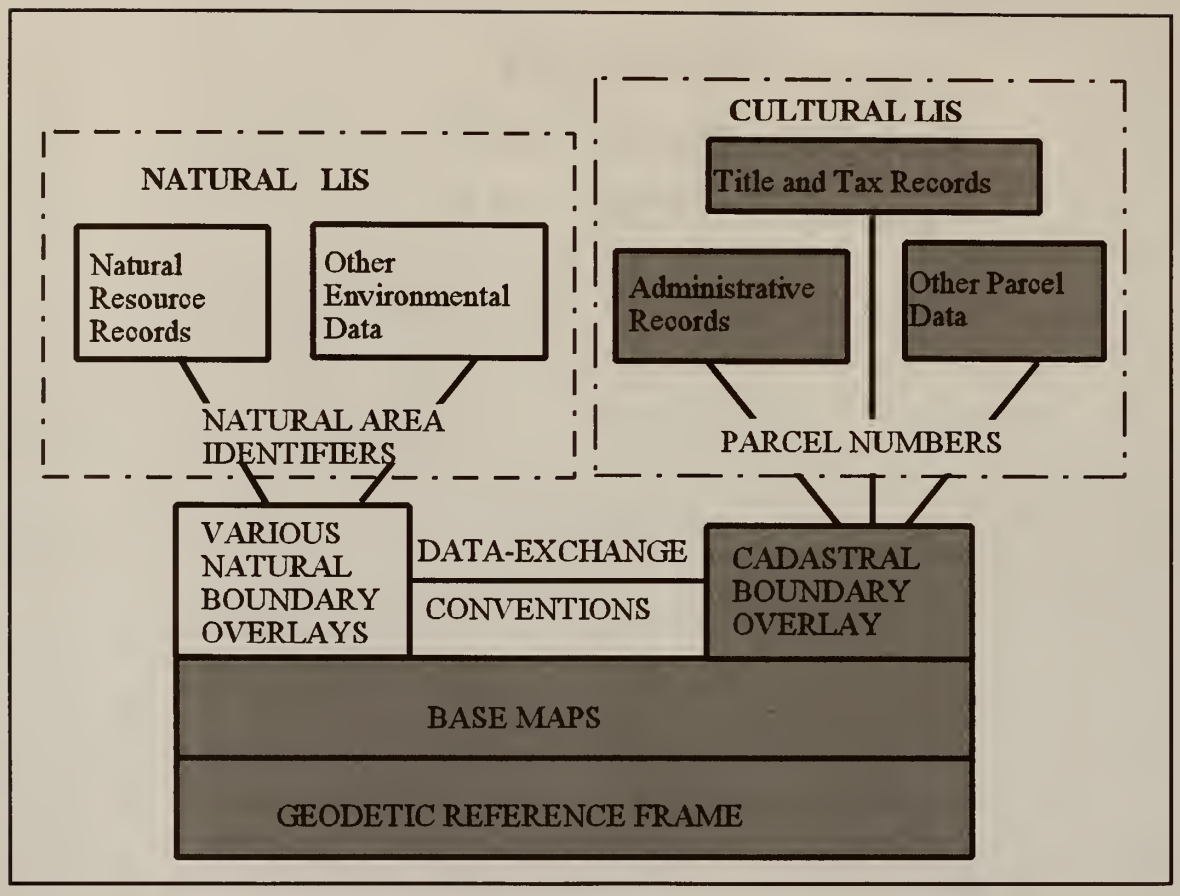


Figure 3-1: NRC Model for a Multipurpose Cadastre (Highlighted)
Source: NRC (1983)

use within the North American continent. The NRC model identifies the components of a multipurpose cadastre. A distinction is made between natural land information system and cultural land information system. The model combines the cultural with the natural land information system to form the multipurpose land information system. Whereas the cultural LIS is based on the cadastral parcel boundaries, the natural LIS is based on other natural boundaries. The two systems are spatially connected by a unifying geodetic reference framework and the base map with data exchange conventions between the two data types. The NRC model advocates the use of base maps containing natural and cultural features

tied to each other in accordance with the level of accuracy with which the feature was surveyed. The model proposes a reliance on the mapping standards that have been established by the American Society for Photogrammetry and Remote Sensing and the National Mapping Accuracy Standards which were established by the Office of Management and Budget.

Williamson's Model

Williamson's model which was also developed with regard to the changing needs of society, was designed in 1986 for Australia. The model is a centralized cadastral information system which provides legal cadastral information support for local government agencies. On the basis that a registration system is integral to the implementation of the cadastre, Williamson attaches the same level of importance to land registration as the cadastral overlay. The model attempts to show the importance of the cadastral map and land registration in the design of a multipurpose land information system, especially in Australia, where tenure security is guaranteed by the State. Here also the topographic base map emphasizes the need for the base map on a geodetic reference framework to ensure spatial consistency. The Williamson model obviously, does not consider natural resource and environmental records as integral components of a multipurpose land information system. Besides, the structure is identical to the cultural LIS component of the NRC model except for the fact that Williamson's model proposes a land information center as a link between the cadastral database and databases of independent government authorities are established (Williamson, 1986).

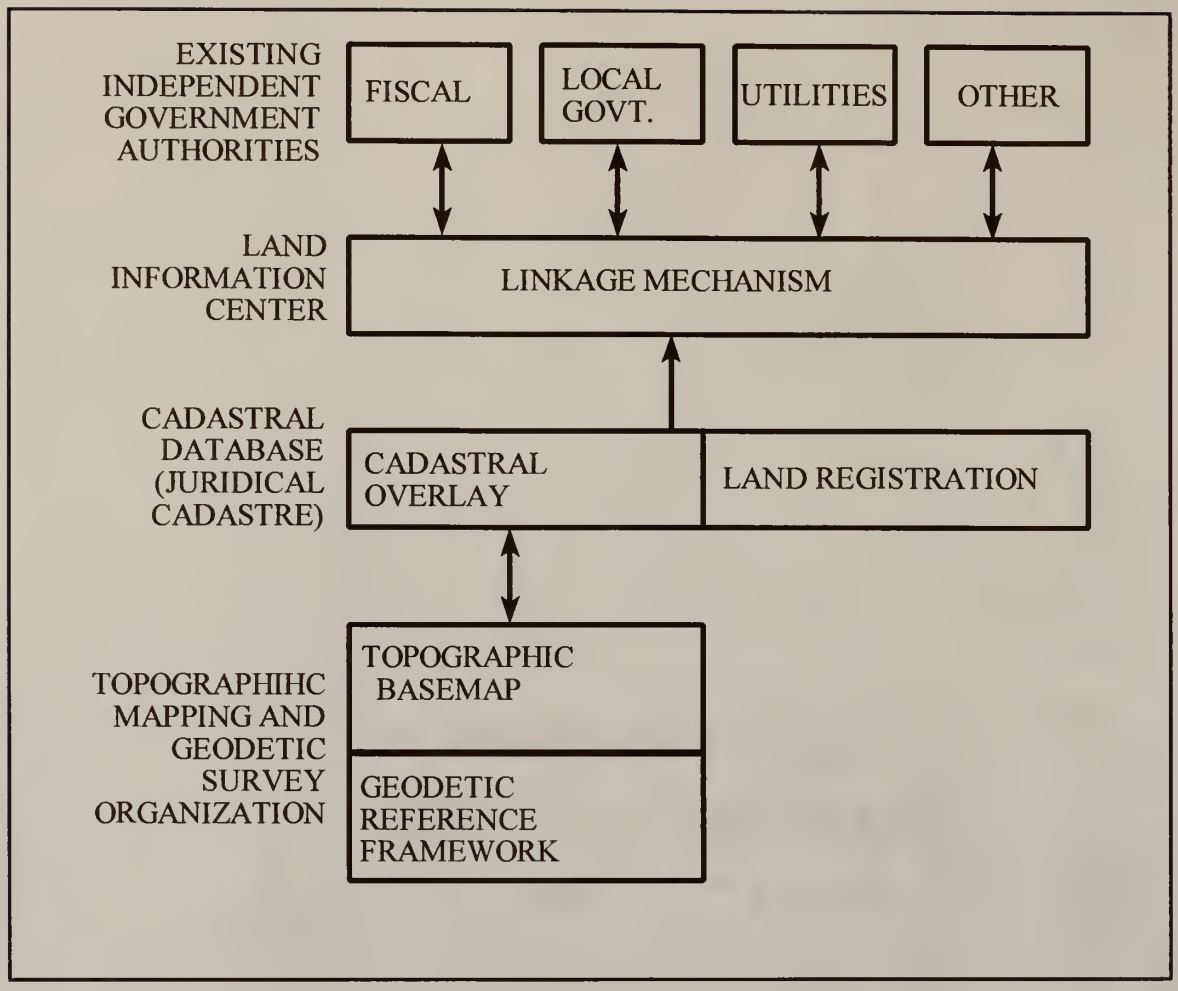


Figure 3-2: Williamson's Multipurpose Land information model
Source: Williamson (1986).

The Developing Country Model

This was developed by Williamson and Jeyanandan in 1990 with particular reference to developing countries (see Figure 3-3). The model recognizes interaction between people, land, social groups and cadastre. In this model, block parcels which seem to be the underlying graphical layer are not tied to any geodetic reference framework. There is no indication as to how the cadastral map will be registered with other maps

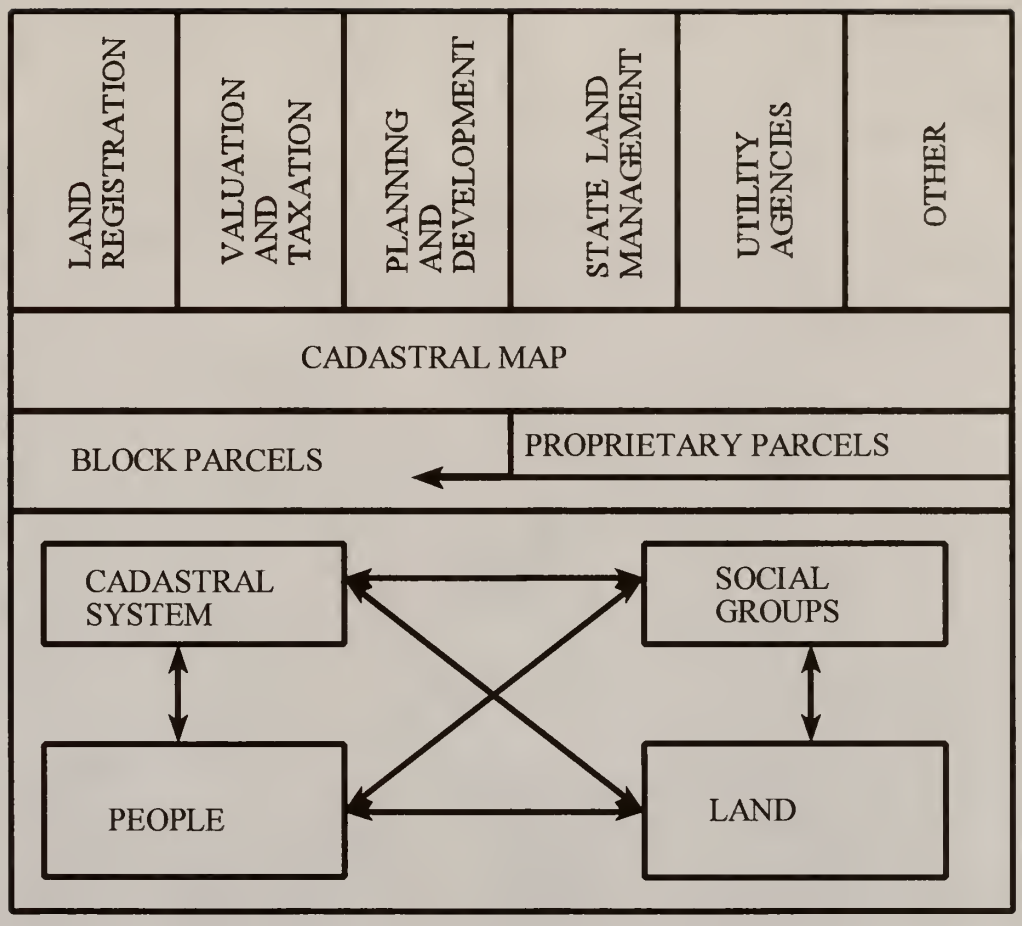


Figure 3-3: Cadastral Model for Developing Countries
Source: Jeyanandan and Williamson (1990)

produced by other agencies. Also this model focuses on cadastre and does not consider natural features as a component of the land information that will be required by say, the planning and development agency. The cadastral blocks are designed around the social groups. Block boundaries, which may be individual communities, form the basic unit of the cadastral map, and are relatively permanent and identifiable on the ground. Proprietary land parcels within the blocks are also recognized. According to Jeyanandan and

Williamson (1990, 91), the special features of the model are;

- Boundaries of blocks are relatively permanent, identifiable on the ground and therefore recognized even without maps.
- Enables preferences for cadastral products through comparison between blocks and selective education of people, who hold rights within a block.
- Enables evolution of cadastral system and facilitates selective intervention in land issues.
- provides the basis for reorganizing land and other data on a geographical (block) basis.
- Flexibility in, the size of the blocks, use of technology, and cadastral practices.
- Involves very little additional resources but provides for orderly improvement of cadastral system in keeping with user demands in specific spatial areas.

The Wisconsin Land Information Model

The Wisconsin Land Information Program was initiated in 1985, in response to demand for information about the land by both the private and public sectors of the community. A multipurpose land information system for the state of Wisconsin was established in recognition of the fact that:

" • a wide variety of land records exist in the form of record books, paper files, maps, charts, and many other formats.
• different land records might be collected at varying levels of detail and accuracy or might be mapped at different scales (Merideth et al. 1990, 79)."

The system was developed to provide among other things, a standard foundation for

accurate geographic referencing of land information. The requirement was an accurate large scale maps which show small areas in detail. To the committee, details were essential for decision-making because of their ability to allow comparison of the areas and attribute of various locations. To a large extent, the Wisconsin model followed the North American MPLIS(1983) model except that instead of a base map, layers of homogeneous accurately surveyed graphical layers such as parcels, zoning, flood plains, soils, and registered together with a geodetic reference framework (NAD83). This approach provided the option to form composite overlays by integrating layers as needed. For accurate graphical overlays, Digital Line Graphs (DLGs) of 1:24000 scale and 7.5 minute topographic maps were initially used with the understanding that more accurate, precise, or detailed information would be incorporated into the system whenever they become available (Wisconsin Land Records Committee 1987, 23).

The unique thing about the Wisconsin program is the separation of the layers and the ability to form composite overlays. However, the need for accurate graphical layers implies that, for a country like Tanzania, where data have been captured with different levels of detail and accuracy would necessitate a re-survey of the jurisdiction in order to obtain a map whose accuracy is uniform across the entire jurisdiction.

Other researchers (Fourie 1993; Davies and Fourie 1996) hold the view that the model should be dictated by the social structure. Modern cadastral information systems consist of three parts; a graphical database which contains information that depicts the subject land, a descriptive part which may be one or more databases containing the list of

proprietors and other descriptive information that are relevant to different operational agencies, and a linkage mechanism which in most cases is the parcel identifier that links the graphical and descriptive databases together. Irrespective of the cadastral model, institutional arrangements and management procedures, organization of these components affect the usefulness and applicability of the cadastral information.

Spatial Data

"The base map is a graphical representation, at a specified scale, of selected fundamental map information, used as a framework upon which additional data of a specialized nature may be compiled (NRC 1983, 37)". Within the context of a cadastral information system, the base map

> " ... provides a primary medium by which the locations of cadastral parcels can be related to the geodetic framework; to major natural features such as bodies of water, roads, buildings, and fences; and to municipal and political boundaries... (NRC 1983, 39)."

Procedures for capturing and presenting graphical cadastral data as well as for producing base maps have undergone technological changes. The biggest changes are occurring in the application of aerial photography for base mapping purposes. Over the years, base maps have been produced from rectified and unrectified aerial photographs, and digital maps, in either vector or raster formats. Advances in computer technology are opening new ways for processing aerial photographs for cadastral purposes, such as softcopy photogrammetric methods. In the next section, issues related to current spatial data capture methods are discussed.

Spatial Data Capture

In the past, cadastral boundary data have been captured by traditional ground survey methods. Equipment for such types of surveys have ranged from the plane table, tapes and compasses, and transit theodolites to electronic distance measuring (EDM) devices. Whereas these instruments have not been eliminated completely, Total Stations and Global Positioning Systems (GPS) technology have become equipments of choice. Cadastral boundary data are depicted as vector representations of the spatial features. Aerial photography has gained popularity due to cost and time savings when surveys of large areas are involved, and also, the fact that photographs enhance the communication of spatial information. People naturally relate better to information depicted on photographs than on conventional line and symbol maps. GPS methods have also been used to extend survey controls so that aerial photography or other ground survey methods can be used to capture the data. Aerial and other photographic forms of data capture are often converted into raster representations.

Although spatial accuracy is not the focus of this dissertation, it is worth mentioning that the ground resolution of pixels in the raster image influences the spatial accuracy of the features. The use of GPS for cadastral surveying is still in its infancy (see Barnes and Eckl, 1996), although the results are promising.

Parcel Identifiers

In any computerized records system, special techniques are required to define and uniquely identify the land objects or entities about which data are to be recorded in order to associate the graphical database with the attribute information. In 1972 the committee on Compatible Land Identifiers: Problems, Prospects and Payoffs (CLIPPP), noted that parcel identifiers have to be unique, simple, permanent in utility, flexible, economical and accessible (Fisher and Moyer, 1973). Recommendations from the CLIPPP committee included the use of coordinate of the centroid of parcels, the maximum and minimum values of the Easting and Northing coordinates of the parcel, and the block system, whereby the blocks are given sequential numbers. The National Research Council of Canada (1976) identified three methods for unique parcel identification; the hierarchical system, grid-based identifiers, and hybrid identifiers.

Hierarchical identifiers represent parcel entity identification structure based on stratified political or administrative units such as Federal, State, County, Town, Ward, Block, and lots. Other forms of hierarchical structure are the Public Land Survey System which is used in most of the United States, as well as the Census Tract and Block system.

Grid or graticule system involves the identification of parcel entity based on geographical or Cartesian coordinate system in a spheroidal or ellipsoidal system. The centroid or the maximum and minimum coordinates of the boundaries are used as the grid identifier. The disadvantage is that, as the coordinates are adjusted occasionally due to improved measurement technology and better mathematical model for the shape of the

Earth, the identifiers would have to be corrected with every modification of the coordinates.

The min-max approach also assumes that all parcels will be rectangular in shape. For a hexagonally-shaped parcel however, the min-max coordinates will lie in someone else's property. The same situation may occur for an L-shaped parcel if the coordinates of the centroid of the parcel is used as the identifier.

The NRC (1983), considered name-related, alphanumeric and location-based identifiers. Name-related identifiers associate individual names and the legal entities over which their interests exist. The grantee-grantor index is an example of such association. Ignoring the fact that duplicate names are common in many jurisdictions, name-related identifiers require that identifiers be changed whenever an interest in the parcel gets transferred.

Whereas there is no dominant choice for a unique parcel identifier, computer technology and database management systems facilitate the use of multiple indexes for a multi-purpose land information system. As noted by NRC (1983, 64), the ultimate choice for a parcel identifier should be dictated by local needs and resources such as the need for accessibility and effective management of the identifiers. In this regard, uniqueness, simplicity and economy of maintenance are more important. Since the CLIPPP conference, different jurisdictions such as Dade, Palm Beach, and Broward counties in Florida, have developed suitable, yet independent, parcel identifiers internally.

Data Management

One of the responsibilities for Land Information Management personnel, is to integrate the graphical record with descriptive information from other databases. The technology for maintaining and manipulating database has been undergoing evolutionary changes since the early 1960s. In this section, databases that are currently operational as well as those that are in developmental stages are presented. Their applicability to land information management and analysis are discussed in order to justify a suitable choice of database technology for the Tanzania project.

The evolution of modern data organization methodologies began in the early1960s with the development of System Design Life cycles (SDLC) (Lee, 1997). Such systems provided some control over the organization of the data but limited assistance with regard to analytical operations (Rhine, 1995). Data were stored in flat files, hierarchical files, network files, etc. Structured methodologies which evolved in the 1970s provided more effective analytical tools and extended design methodologies. These were achieved by structuring the data into elemental forms and focusing on the modeling of entities and data. Codd's (1970; 1979) relational model, along with the structured query language (SQL) gained support because it provided LIS users with query capabilities which were not available before. The logical structuring of the data determined the degree of flexibility within the system. However, the inherent deficiencies in the relational database model and entity relationship concept influenced the object-oriented methodologies of the 1990s (Yourdon 1994).

Object-oriented technology is regarded as the cutting-edge approach for data modeling, analysis and software design (Lee 1997). The object-oriented principle is based on the assumption that people generally think in terms of objects rather than entities or functions. Objects are direct representations of real things that people perceive when communicating or describing characteristics of entities or things (Yourdon 1994; Usery 1996). The object-oriented principle incorporate the inheritance and encapsulation characteristics of data into an integrated whole (Yourdon 1994). Despite the power of object-oriented technology, very few software packages have been developed to harness the capabilities of the technology. Below is a description of the data file formats that are currently in use for LIS operations and their advantages.

Flat Files

Flat files are traditional "spread-sheet type" systems without full database management support. Flat files contain tabulated data in rows and columns. The rows contain the records and the columns represent the fields or items. Ordering of the rows within the table has importance for the ways in which data can be accessed. Data retrieval is done by means of search keys which index the occurrence of values for a specific field. Any item (column) within the table can be used as the search key. Searches within the table may be done sequentially, by binary search, or by index search. The efficiency of sequential search depends on the location of the record which is being searched. If the search key is changed to another item within the table, the table has to be sorted again with the new key.

A faster, yet resource intensive, method is the Indexed search which relies on a separate index table to search for records. A separate table containing the key of every record as well as an address pointing to the data location of each key is associated with the data. The index is sequenced and the search is done on the index rather than the data itself. Because the index table is smaller than the table of data itself, searching of records is faster.

Even though early LIS implementation used Flat files to associate the graphical overlays, Flat files are severely limited in their utility to LIS applications due to their limited flexibility. They are simple and efficient for specific repetitive tasks such as transaction-based information (e.g. in the retail industry and banking activities).

Hierarchical Files

Hierarchical database system works like a "family tree" relationship. With hierarchical files there is always more than one record in the file. One record is the "parent" or master, and it can be associated with any number of "children" or detail records through internally assigned pointers. The detail records can also have children assigned to them. This establishes a one-to-many relationships among the files. The advantage of this system is that it allows multiple sets of identical attributes to be associated with any given record without storing those repetitive data in separate files. Linking of files is done with pointers which provides some flexibility in relating data between records. One major limitation with the hierarchical file system is the fact that data in the detail record can only be accessed by first accessing the master record.

Networks

An improvement to hierarchical files are the Networked databases which allow detail records to be accessed with more than one master record. This establishes a many-to-many relationship between the files. The advantage is that if any record needs to be updated, it can be done on only one file. The drawbacks to the networks are as follows:

- Logical linkages among files multiply as new databases are added to the system.
- In complex networks involving large databases, the amount of storage required for the pointers can be larger than the database itself.
- Management of the pointers, as records are added, new fields created, and linkages created as data values change can become cumbersome and in danger of being inflexible.

Relational Databases

The relational database concept was developed by Codd in 1970 (Date 1991, xi; Healey 1991, 257). The concept is based on the mathematical theory of relational algebra. Relational databases allow related records from different tables to be associated without the use of pointers. Relationships are established through common items within the structure of the tables. Values in a column or columns in one table are matched to corresponding values in the column or set of columns in another table. From the second table another set of matching tables will be associated. The linking continues until all the databases have been joined. In order to prevent data redundancy in the relational system due to the

commonality of items in the relations, relational designs follow Codd's theory of normal forms (Healey 1991, 258-259) which specifies that:

1. All tables must contain rows and columns and atomicity (i.e. no repeating groups of data) should be enforced among values within columns.
2. Every column which is not a part of the primary key must be fully dependent on the primary key.
3. Every primary key must be non-transitively dependent on the primary key.

Normalization. The join mechanism matches column values between tables using the common item. Normalization of the relational system is based on the principle that a set, as mathematically defined, cannot have duplicate values. Since a table is a set, it cannot have rows whose entire contents are duplicated. In addition, each row must be different from any other. It follows that the values in a single column or a combination of values in multiple columns can be used to define a primary key for the table. No column that is part of a primary key can have null values since this could have the potential for permitting duplicate values. Healey (1991) lists the advantages of the relational databases as follows:

" 1. Rigorous design based on sound theoretical foundation.
2. All other forms of database structures can be reduced to a set of relational tables, so they are most general form of data representation.
3. Almost unlimited flexibility in forming relationships among data items without the limitation of linkage management.
4. Ease of use and implementation compared to other types of systems.
5. Modifiability which allows new tables and new rows of data within the tables to be added without difficulty.

6. Flexibility in ad hoc data retrieval because of the relational join mechanism and powerful SQL facilities (Healey 1991, 259)."

Due to the volume of data that may be associated with a typical Land Information System, Database Management Systems (DBMS) have become integral to LIS. Data modeling techniques, such as entity-relationship model, have become the key element in designing spatial databases. The Relational model has dominated LIS database applications due to the design of commercial software to harness the advantages of the relational construct over older models such as inverted lists, hierarchical files and networked files. The relational database model with the Structured Query Language (SQL) was chosen system for Tanzania. It is recognized at this stage that as the object-oriented technology gains popularity among land information managers, the land administrators might change to the object-oriented system.

In the next chapter, attention will be focused on the administrative arrangements which support land management activities in Tanzania. A study of these arrangements as well as data processing procedures will be analyzed in order to develop approaches for modernizing the cadastral records and implementing land information system for Tanzania.

CHAPTER 4
EXISTING CADASTRAL ARRANGEMENTS IN TANZANIA

Following the discussion on land management taxonomy in Chapter 2, where typical land administration agencies were identified together with the necessary information support systems, a review of current issues in the data capture and management activities were discussed in Chapter 3. This chapter deals with the land management arrangements in Tanzania, the responsibilities of the established agencies, and their data capture and data management procedures. In this chapter, problems with existing land management arrangements and procedures are identified. A study of the history of Tanzania reveals that some of the problems associated with the Tanzania land delivery process can be traced to colonial times. A brief review of the evolutionary process of the current land tenure system in Tanzania has been given in Appendix B. Approaches are developed in the subsequent chapters to eliminate or reduce the impact of the problems.

At the State and regional levels, land management administration in Tanzania is handled by the Ministry of Land, Housing and Urban Development (MLHUD). At the local level, the responsibility falls on the Ministry of local government. Reorganization of land records in Tanzania required a study of the land management arrangements that have been instituted by the government. This study was accomplished through field visits to thirteen of the twenty regional capitals and interviews with land administration officials in

both the regional and local government offices. The study focused on the legal instrument and operational guidelines that defined objectives and responsibilities, organizational arrangements for meeting those objectives, and data capture, storage and processing methods, record management practices, and information dissemination, both internally and with other agencies. The responsibilities of agencies that operate on a national level were compared with those that operate on a local level, in an effort to identify overlapping or conflicting responsibilities between agencies. The results of this study provided the basis for the land record reorganization approach and data processing methods. In order to understand the land management arrangements in Tanzania, the administrative arrangements within which land management activities are described.

Administrative Arrangements within Tanzania

Tanzania is divided into 20 administrative regions (see Table 4-1), each region having a capital city. For administrative purposes, the city of Dar es Salaam, which is the national capital is also a region by itself. So is Dodoma, the proposed State capital which will replace Dar es Salaam once the infrastructure development has been completed.

Table 4-1: Administrative Regions in Tanzania

Dar es Salaam	Arusha	Mtwara	Kigoma	Iringa
Coast	Tanga	Lindi	Mara	Rukwa
Morogoro	Dodoma	Mwanza	Shinyanga	Ruvuma
Moshi	Singida	Kagera	Mbeya	Tabora

Each region has offices for regional planning, surveying and mapping, land and title registry. However, all major land management decisions concerning all the regions are made in Dar es Salaam, except Dodoma which by legislation, has autonomy in land management decisions.

At the national level, the Ministry of Land, Housing, and Urban Development is responsible for land planning, allocation, title processing and registration, property valuation and assessment, and legal issues in land within Tanzania. These responsibilities are handled by the Urban Development, Surveys and Mapping and Land Development, Valuation and Legal divisions in the Ministry (see Figure 4-1). Sections with specific responsibilities have been described below.

Organizational Arrangements within MLHUD

The Urban Development Division

The Urban Development Division currently operates under the Tanzanian Town and Country Planning Act of 1956, which was revised in 1961. The Division is responsible for defining and planning the use of all public land in Tanzania. Activities of this Division include planning redevelopment areas, renewal of blighted urban areas, re-designation of land use, and monitoring of development to ensure compliance with the development program in accordance with master plans of cities. The division is headed by a Director of Urban Development. The Director of Urban Development approves all town and village layout plans prior to implementation. The Urban Development Division has five main

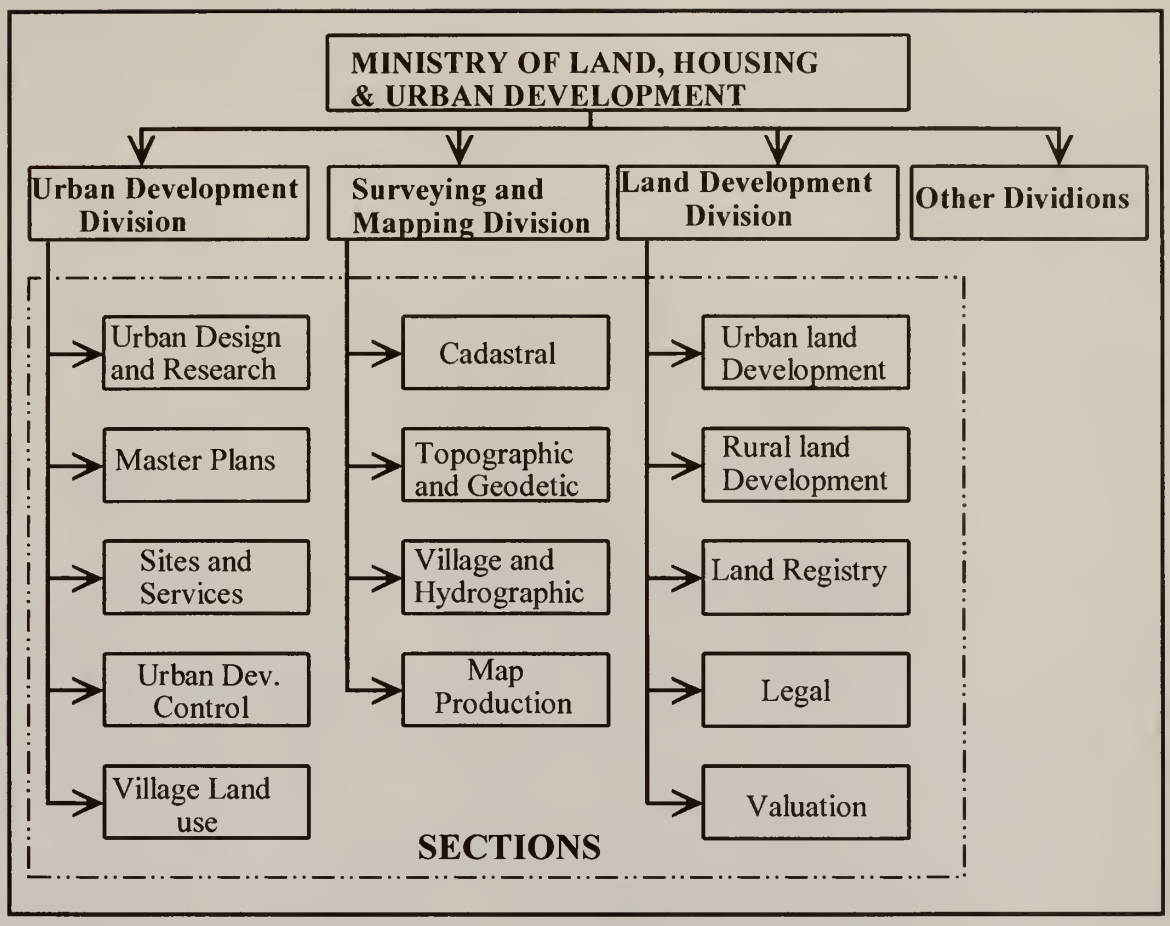


Figure 4-1: Organizational Chart of MLHUD

sections which are the Urban Design and Research, Urban Development Control, Master Plan, Village Land Use Plan, and Sites and Services sections.

The Urban Design and Research section. This section is headed by a senior principal town planner. The responsibilities of this section include planning redevelopment areas (such as the central areas of Dar es Salaam), renewal of blighted urban areas, and controlling the layout designs of the city. In addition, staff within this section conduct research and designate high-, medium-, and low-density development areas. Classification of development areas is based on socioeconomic studies of the communities within the

area. The result of the study becomes the basis for setting the size of individual lots within the proposed area. High-density areas consist of small plots for low income people. The parcels are usually 400 square meters in size. Medium-density plots are slightly larger with sizes ranging between 400 and 800 square meters. Low-density classification is for residential areas for high-income people. The plot sizes are between 800 and 1600 square meters. The size of the land allocated for industrial use varies depending on the intended use.

The Master Plans Section. This is the section where master plans are prepared. It is the policy of the government of Tanzania, to have five-year development plans for all rapidly growing urban areas in Tanzania. The development plans are graphical layouts showing the allocation of land for various uses in accordance with the rate of expansion of the city. The development plans are referred to as the master plans. The Urban Planning Division schedules the areas to be planned in accordance with available funds however, councils within fast growing municipalities can request priority consideration for physical planning of their community. In such circumstances, the municipal councils provide some of the cost of preparing the master plans

Currently, there are up-to-date master plans for all major cities except Dar es Salaam which was last prepared in 1979. The reason for failing to update the master plans for Dar es Salaam is purely it cost which would require a large proportion of the resources of the Division. This implies that the master plans of other cities will not be updated for some time.

The Sites and Services Section. The main activities of the sites and services section are for planning of squatter settlements, ensure that basic infrastructure such as roads and water are available to the residents of those settlements, and that development plans are carried out according to the design. Activities performed by this section are multi-disciplinary and not restricted to planning. This section operates on a project-by-project basis. The activities of the section are concentrated in Dar es Salaam.

Urban Development Control Section. This section ensures that development agencies adhere to the existing master plans and to ensure that the local councils operate within the development program. The section is responsible for resolving all land conflicts, including those that emanate as a result of planning or allocation. The Urban Development Control section stipulates development conditions and declares areas as ready for urban development. This section ensures that the local councils operate within the guidelines of the development program. The section also supervises the preparation of designs for urban towns. In the regions, the urban town plans are prepared by the municipal councils, but the development control section ensures that the designs conform with the set standards. The section may recommend a change in land use for any particular area. Such changes are recommended to the director and have to be approved by the minister for lands.

Village Land Use Section. The Village Land Use Section assists regional planning officers in preparing village land-use plans.

The Survey and Mapping Division

The Surveys and Mapping Division provides survey services to government agencies, maintains a geodetic survey control network, and prepares and maintains cadastral and topographic mapping statewide. The Director of Surveys is responsible for coordinating all public sector mapping activities and for maintaining records of all maps, plans and surveys completed by government agencies. As shown in Figure 4-1, the Division has four sections that deal with various aspects of surveying. The sections are cadastral, topographic and geodetic, village and hydrographic, and mapping. There is a survey department in each of the twenty regions in Tanzania. Although the regional surveyors are responsible for the cadastral surveys within their regions, all surveys must be checked in Dar es Salaam before they are accepted. This is a major bottleneck in the data processing procedures within the Division. Surveyors are required to submit their field notes, computation sheets, and a plot of the survey to Dar es Salaam for checking. A six-man field computation checking team in Dar es Salaam has the responsibility of checking survey work from the regions. For a timely computation checking process, the regions in Tanzania have been divided into six zones and a technician is responsible for each zone.

The Cadastral Section. The cadastral section deals with demarcation of plots in accordance to town planning drawings. These are physical layout plans for a development area. The cadastral section is responsible for the custody of all original field survey records and checking of computations of surveys from the regions. The demarcation layout from the Urban Development division is submitted to the cadastral section on a base map which

may or may not be current. In laying out the demarcation, the surveyor has the authority to change the design if he or she encounters any obstacles, such as existing houses or roads that conflict with the town planning design. The surveyor lays out the plots as closely as possible to the town planning design, but resolves conflicting issues on site. He or she then surveys the corner monuments to obtain final coordinates. Staff at the computation unit check all control surveys and demarcation surveys for computational and drafting errors and recommend approval or rejection by the Director of Surveys. Deed plans of individual plots are prepared from approved survey plans after the lots have been allocated.

The Topographic and Geodetic Section is responsible for all survey projects that are related with national mapping and the establishment and densification of national geodetic control network. The section is further divided into four units:

1. The geodetic surveys unit is responsible for planning, monumentation, surveying, documenting, and maintaining national geodetic control points. The national geodetic controls are first order, second order, third order, and precise leveling for national vertical bench marks. The section has not executed any control extensions for many years. Planimetric control densification is currently conducted by cadastral surveyors whenever they need to extend control to a project site. Besides that, no precise leveling has been done in several years.
2. The topographical survey unit is also responsible for all topographic surveys, national mapping, and for providing data for the production of cadastral base maps and national maps at various scales.

3. The international boundary surveys unit maintains the national boundary monuments and is also responsible for resolving national boundary disputes.
4. The stores and equipment unit is responsible for logistics. The unit purchases survey equipment, stores and maintains surveying instruments and camping equipment for the topographical and geodetic section. The unit is responsible for keeping stock of stationery, such as field survey forms and other materials needed by other sections for performing their normal tasks.

Village and Hydrographic Surveys Section. The village mapping section was established in 1970 in response to the government's desire to institute village governments that would be the nuclei of national planning and development. The Village and Ujamaa Act of 1975 required that village boundaries be known. One of the responsibilities of the village and hydrographic section is to demarcate and establish village boundaries so that title may be issued to the village committees. The section is headed by a senior surveyor who is responsible for the planning, coordinating, and monitoring of the implementation of village mapping projects.

Village mapping activities involve a series of seminars with the residents of the village that have has been earmarked for mapping. The rationale of the seminars is to educate the villagers on the intent and purpose of the demarcation survey and for the surveyors to learn about their customary land tenure system in order to ensure that residents are not unduly dispossessed of their property. The village mapping team uses 1:50,000 base maps and aerial photographs to map out village boundaries. The team visits

the boundary marker (if one exists) or establishes a boundary identifier at the position that is mutually accepted by the representatives of the adjoining villages. The photo interpreters identify the boundary marker in the photograph or its location (if the point is not on the photograph). A number is given to the point and a textual description of its location is made. In the office, a map is produced by photogrammetric methods and submitted to the director of surveys for checking and approval.

Map production section. This is the section that is responsible for the cartographic production of thematic, topographic and special purpose maps and atlases. Maps of all categories, with the exception of the 1:50,000 scale-map series, are produced by the staff in this section. The 1:50,000 scale-map series are normally contracted to overseas contractors such as the Ordinance Survey of The United Kingdom or Kenting Surveys of Canada.

Land Development Division

The Land Development Division deals with allocation of parcels, preparation and issuance of titles, valuation and assessment of properties, registration of titles and encumbrances, and resolution of disputes involving ownership. Responsibilities and activities within this Division are regulated by the Land Ordinance (Chapter 113) and the Land Registration Ordinance (Chapter 334) of the laws of Tanzania. These laws declare all lands to be under the control and subject to the disposition of the president.

Some of the powers of the President to administer the land have been passed to the Minister for Lands and subsequently, to the Commissioner for Land. Government Notice 124 of March 22, 1963 extends the power of disposition to land officers. In the office of the commissioner for lands, specific land officers have been assigned the responsibility to allocate land.

The Land Development Division has five sections (see Figure 4-1). The division deals with all public land administration matters in Tanzania. The division is headed by a commissioner for lands, whose responsibility it is, to approve all land allocations and to endorse all certificates of occupancy. The commissioner's office maintains records of all land transactions that pass through the Land Development Division. There is, therefore, an open registry where records of all transactions relating to lands in Tanzania are kept. There are five main sections in the Land Development Division; urban land development, rural land development, land registry, legal, and valuations sections.

Urban Land Development Section. This section handles all matters relating to urban land including;

- preparation of Certificate of Occupancy in urban areas;
- processing of land allocations that are made from the commissioner's office;
- resolution of ownership dispute; and
- approves transfers, mortgages, and leases that last longer than five years.

Rural Land Development Section. The Rural Land Development section has the same responsibilities as the Urban Land Development Section, but with regard to rural areas. In addition, this section deals with matters concerning the allocation of land for large farms, the processing of village titles, rights of occupancies in village areas, trading areas, and subdistricts.

The Land Registry is headed by the registrar of titles, who is responsible for all the titles that are issued in the country. For land registration purposes, Tanzania is divided into six zones. Each zone has a registry that is headed by an assistant registrar. Zonal registries are located in Dar es Salaam, Moshi, Mbeya, Mwanza, Mtwara, and Dodoma (see Table 4-2). This grouping is inconsistent with the grouping at the Surveys and Mapping Division. The zonal registrars have the mandate to register titles within their zones. The

Table 4-2: Land Registration zones in Tanzania
(Zonal headquarters in italics)

Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Dar es Salaam Coast Morogoro	*Moshi* Arusha Tanga	*Dodoma* Singida	*Mtwara* Lindi	*Mwanza* Kagera Kigoma Mara Shinyanga Tabora	*Mbeya* Rukwa Ruvuma

responsibilities of the registrars has been clearly defined in the Land Registration Ordinance (Chapter 334) of the laws of Tanzania. Three classes of documents can be registered at

the land registry: Certificate of Occupancy, land-related transactions, and collateral. Chapter 334 of the Tanzanian laws lists 33 items that may be registered. Of these, 21 have so far been submitted for registration. Some of the items submitted for registration include acquisition of Right of Occupancy, caveat, registration as legal personal representative, change of ownership, change of name, deed of variation, mortgage, revocation of right of occupancy, and land transfer. After the commissioner has endorsed the certificate of title, the document is sent to the zonal registries for the title to be issued. There are two systems for registering certificates of occupancy--the "old system" and the "new system." Both systems are described later in this chapter, but it will be mentioned at this point that the major differences between the two systems are the numbering system and the filing method.

The Legal Section. It is the responsibility of the legal section to review all the land laws of Tanzania, identify loop holes, and conflicting areas of the law. The legal section recommends modifications to the attorney general. The activities of the legal section include the preparation of deeds of variation, deeds of surrender, and deeds of rectification. In addition, the legal section prepares the background information and strategy for defense in all land-related legal actions brought against the Ministry and to coordinate with the attorney general in the defense of the Ministry. One of the legal actions the section handles includes claims for annulment of revocations of certificates of occupancy that were made between 1971 and 1992 that were signed by the minister for lands. The legal standpoint is that the minister did not have the mandate to sign those revocations. According to the law, only the president can revoke an allocation of land.

Other cases include resolution of legal action instituted as a result of double allocation and failure to follow the correct procedure either for revocation or reallocation.

The Valuation Section. For first time allocations, a land assessment report is required to establish the fee to be paid by the applicant upon acceptance of the offer from the allocating committee. It is the responsibility of the valuation section to assesses the land rent. Actual property valuation is done to establish the value of improvement or developments that have been carried out on the land when the values are needed for compensation, mortgage, transfer, or the determination of rental charges on a house. The procedure for assessing rent for first time allocations id described later in this chapter.

The City Council of Dar Es Salaam

The City Council is a completely independent authority that operates under the Local Government Act (1982) to develop and manage the resources within the city. The council operates under the Minister for Local Government. This enables the City Council to operate independently of the Ministry for Lands, Housing and Urban Development. The Dar es Salaam City Council has jurisdiction over three districts; Ilala, Temeke, and Kinondoni. Each district has a district lands officer. The City Council has its own land surveyors, town planners, valuers, architects, and land officers who operate independent of the Ministry of Land Housing and Urban Development. However, the town planning drawings that are prepared for demarcation have to be approved by the director of urban development before allocation can begin. The City Council maintains and updates its own

set of standard sheets (1:2500 scale maps), which the council uses as base maps for the preparation of town planning drawings.

The Local Government Act (1982) authorizes the City Council to establish the requisite administrative divisions to enable the council to function efficiently and effectively. The City Council is guided by the policies of the Ministry of Lands, Housing and Urban Development. Although the functions of the two ministries are clearly defined, there seems to be overlapping responsibilities. The effect is that the two ministries sometimes have different views on the resolution of certain problems that are associated with land administration.

Existing Land Delivery Process

Land Delivery in Tanzania is done in two stages. The first stage(see Figure 4-2), which is referred to as survey and demarcation, deals with subdivision of the land, physical demarcation and monumentation of the parcel boundaries, and survey of the parcels. briefly, the process begins with a request from the Commissioner for Lands. Layout plans, depicting how the designated area should be subdivided, are prepared by the Urban Development Division. The Surveys and Mapping division is responsible for demarcation, monumentation and survey of the parcels. In places where the land has never been sub-divided before, adjudication precedes survey and demarcation, to establish ownership and rights to the use of the property. Upon successful checking and approval process, copies of the subdivision plan are passed to the relevant offices including an allocation committee

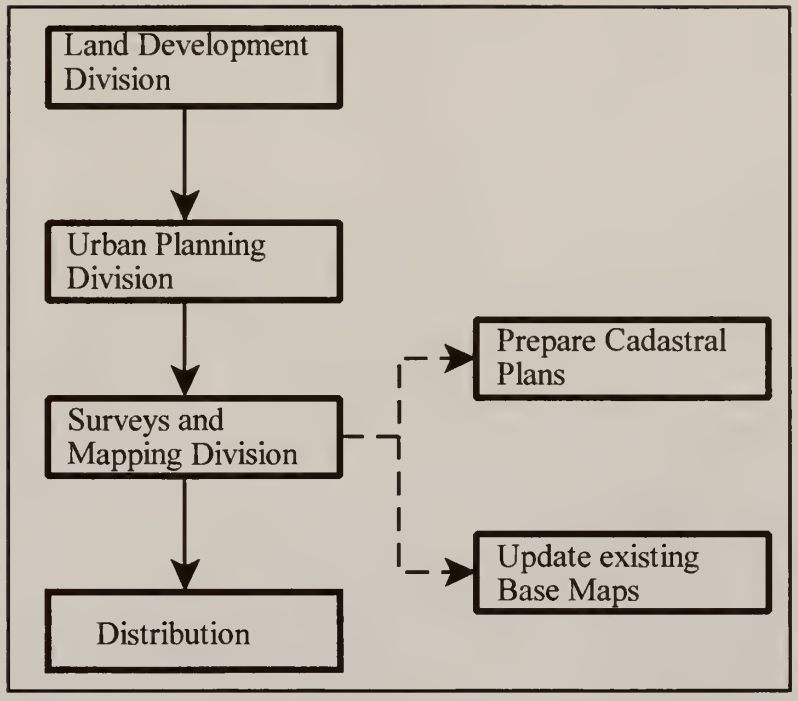


Figure 4-2: Survey and Demarcation

which uses the map to allocate the individual parcels to applicants. The existing base maps are updated with the new information.

The second stage involves allocation of the parcels to applicants, titling and registration of the certificate of title (see Figure 4-3). It is the responsibility of the allocation committee to assign the plots to successful applicants. The Land Development Division is responsible for preparing and registering the certificate of occupancy. After allocation has been done, certificates are prepared and sent to the Commissioner for Lands who appends his seal to the title and endorses each certificate for authentication. The

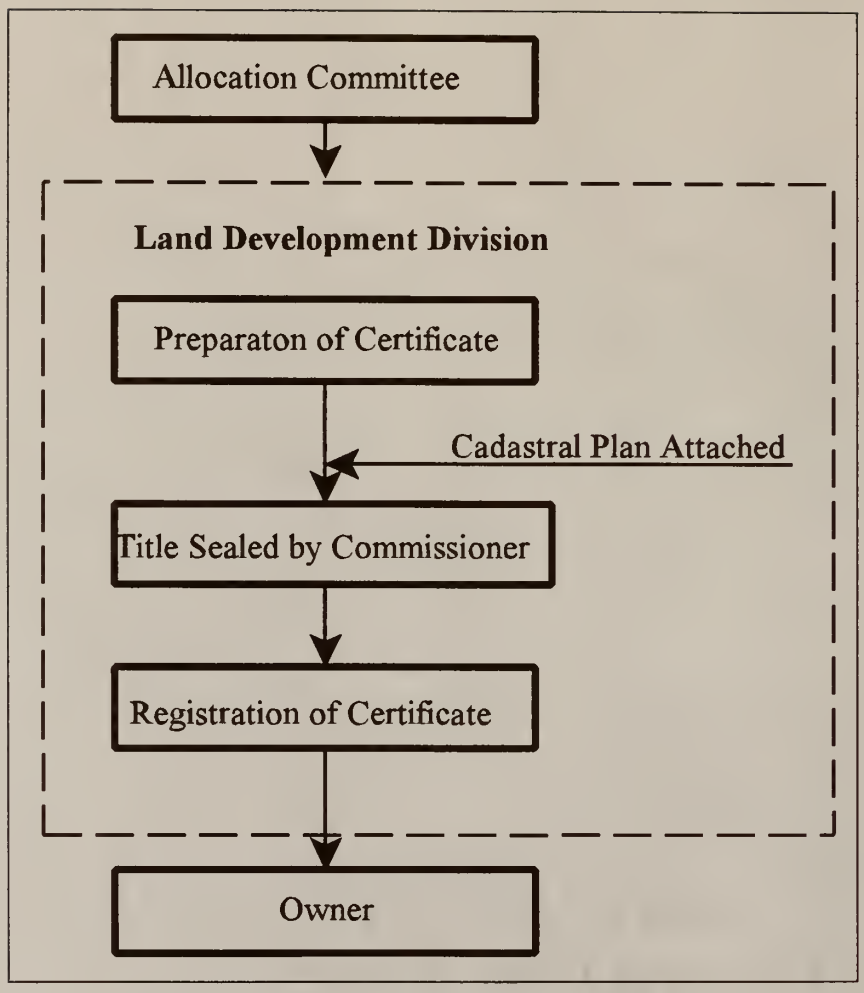


Figure 4-3: Allocation, Titling and Registration

certificate is finally registered by the Registrar of Titles. Copies of the registered documents are then given to the respective owners.

Survey and Demarcation

The process begins with the town planner preparing the layout (which is referred to as "town planning drawing") in accordance with the development phases of the master plan. This is done using the base map of the area of interest. Normally, the town planners should

request the survey division for a current base map. In most cases, the base maps are so old that it is a major task just to update them.

When the town planning drawing has been completed, the local Development Committee has to approve and accept the layout. Upon acceptance, the plan is sent to the director of urban planning for approval. A sepia copy of the approved layout is sent to the region and the original is kept in Dar es Salaam.

A print of the town planning drawing is submitted to the Survey Division with a request for demarcation. The task is assigned to a staff surveyor and execution is done in accordance with survey instructions. The survey instructions are normally issued either by the director of surveys or his representative. After demarcation, the layout is surveyed. Field notes and computation results are submitted to the regional surveyor, who checks the work and sends the completed results to the director of surveys for approval. The director of surveys checks and approves the survey. Prints of the completed plan are made and distributed to the relevant offices. The field notes become the property of the government. A copy of the town planning drawing is sent to the regional lands officer who requested the survey and demarcation. The print received by the regional lands officer is used by the Allocating Committee to distribute plots to applicants.

Allocation and Registration

The land officer prepares a list of applicants who qualify to be considered for allocation. There is a committee that has the responsibility for allocating lands in every district and every town. The list is submitted to the committee that allocates the plots to the

applicants. In Dar es Salaam, there are three allocating agencies. These are the office of the commissioner for lands, the urban planning committee, and land officers (under Government Notice 124 of March 22, 1963). As there are always more applicants than available plots, there is a genuine desire on the part of most members of the allocating committees to distribute the land fairly. In most regions and districts, allocations are done on a first-in-first-out basis. It is, however, difficult to overlook the request of a superior or a politician.

Once allocation has been done, the regional land officer requests the valuation office for an assessment of land rent. There are criteria for assessing the rent for first-time allocations. The valuation officer calculates the appropriate rent and prepares a report. The regional valuation officer checks the figures and approves if everything is correct.
The land officer prepares a letter of offer that is sent to successful applicants. The letter details the fees that need to be paid and the development conditions for that piece of land.

Some of the fees are to be paid at the land office while the other fees have to be paid at the Inland Revenue office. The applicants are supposed to take the evidence of such payments to the Land Officer, even though in most regions the Letter of Offer does not mention it. The land officer prepares the Certificate of Occupancy and requests a cadastral plan from the Surveys Division only when the advice of payments have been presented to him. The cadastral plan is attached to the Certificate of Occupancy. The applicant signs the Certificate of Occupancy before a land officer, a magistrate, or a commissioner of oaths. The document is finally sent to the commissioner for lands (in Dar es Salaam) for checking and endorsement.

At the office of the commissioner for lands, the certificate and all the relevant documents are checked. Those that are found to contain errors are sent to the reception desk pending further communication with the regional land development officer who submitted the certificate. Certificates that are free from errors are stamped with the commissioner's seal of approval and sent to the commissioner for signature. The documents are finally returned to the zonal registry office of the region where the plot is situated, after the commissioner for lands has approved the certificate and the statistics section has extracted the necessary information from the documents.

The zonal registrar checks for any conflict of ownership, the correctness of the deed plan, and anything that is required under Chapter 334 of the Laws of Tanzania. In the absence of any adverse claims or reasons for objection, the title is registered.

Cadastral Surveying Processes within Divisions

Surveying and Mapping Division

The procedure for executing a cadastral survey in a rural area is slightly different from the method that is used for urban surveys. Surveys in the rural areas are mainly for physical demarcation of village boundaries, whereas urban cadastral survey are for plot demarcation and survey. They both start with survey instructions from the office of the director of surveys and mapping or any person appointed by him. In the regions, the survey instruction may be written by the regional surveyor. The survey instructions contain the

coordinates of existing survey controls that may be used to connect and control the new survey as well as a sketch of the area to be surveyed.

Survey of Rural Areas. The survey instructions contain details such as the location and the shape of the land to be surveyed. Adjudication between neighboring communities is done at the time of demarcation to ascertain the mutually accepted position of the village boundaries. Sometimes it is found that the sketch that is attached to the director's instructions is different from what the village communities perceive to be their boundaries. In such circumstances, the boundaries as perceived by the communities are adopted.

Until recently, a photogrammetric method was used to demarcate village boundaries. Using a 1:50,000 scale map and aerial photographs, the boundaries are identified and marked on the photos. Photogrammetric methods are used to coordinate the boundary markers and to produce maps. In situations where conventional theodolite traversing method is used, accuracy requirements for village demarcations are 15 minutes of arc for angular misclosure and 1:5000 in linear misclosure.

Surveys of urban lands are often for physical demarcation and survey of parcels. The request for survey is preceded by an approved town planning drawing. The commissioner for lands or his representative makes a request to the director of surveys and mapping, who in turn, issues survey instructions. The survey instructions are either sent to the Regional Survey Offices or to licensed survey firms. Requests for surveys may also be made in the regions by the regional land development officer to the regional surveyor. The

survey instructions constitute an express authority for the land surveyor to enter upon the land with his or her field assistants to carry out the survey.

Procedure for Carrying out Cadastral Survey. The field surveyor studies the layout and identifies the location from an index map. Any existing cadastral control points in or around the neighborhood are identified. Coordinates, reports, descriptions, and any relevant information pertaining to the controls are extracted from files. All preliminary computations needed to commence the survey task are done in advance prior to the actual field work.

The field procedure for setting out the parcels involves demarcation of the block corners first. Measurements are made to ensure that the block corners have been located as accurately as required in the survey instruction. A traverse is run to coordinate the block corners. The traverse is computed to ensure that the positions of the points are within acceptable misclosures. In urban areas, the allowable angular misclosure is $30n^{1/2}$ seconds of arc, where n represents the number of stations. Allowable linear misclosure is 1:6000. Traverse adjustment is by the Bowditch method.

Setting out individual plots in a high- and medium-density area is done by extending a steel tape horizontally straight along the line between two block corner points and driving iron pins into the ground at the points where plot corners should be. Concrete mortar is poured around the pins to make them more permanent.

In the case of low-density plots, the sides are measured rigorously and corrected for slope, temperature, and where applicable, sag correction. Plot corners are marked with concrete monuments and numbered sequentially. Such numbers are also shown on the

cadastral plans. In the office, the field notes are checked by re-computing all the data to make sure that there are no errors. The surveyed plots are finally drafted. The original field notes, computation sheets, and plan are sent to the director of surveys and mapping for further checking and subsequent acceptance. A job that meets the required standards is accepted and approved by the director. Field notes and all accompanying documents become the property of the government.

In most cases where the survey instructions have been followed and proper survey procedures applied, the resulting survey has been within acceptable tolerances and the job has been accepted. Occasionally, the survey work has been rejected. In such situations, the director of surveys and mapping requests that the work be done again.

Rejection of Cadastral Survey Job. Some of the reasons for rejecting a survey include:

- failure to follow the survey instructions
- failure to conform with the layout as shown on the town planning drawing without adequate reasons;
- failure to comply with accuracy requirements, either as specified in the survey instructions, the Surveyors Regulations, or technical circulars;
- survey work extending over or overlapping an existing survey; or
- non-maintenance of road parallelism.

Relative accuracies of the cadastral control points. Different methodologies have been applied at different times in different parts of the country during survey control densification. Four different approaches have been used to establish survey controls; triangulation method, the use of theodolites and Electronic Distance Measuring (EDM) instruments, theodolites and invar tapes, and lately, global positioning system (GPS) methods. Each of the methods has inherent levels of accuracy. Surveyors in both the public and private sectors expressed the need to readjust the survey control network and obtain unified coordinate values for all the control points as well as established levels of accuracy between the different measuring processes.

New settlements usually start from the edge of the road and extended inland, away from the road. In demarcating plots, the procedure has been to use controls points from the edge of the road and close on other points along the same road. The controls that were established during one cadastral survey were used as starting and closing controls for subsequent surveys. This has been the procedure for extending cadastral controls especially in the urban areas. By doing that, the errors in one cadastral survey got carried over to future surveys.

Over the years, different misclosure levels have increased between different town subdivision blocks along different roads. In the current situation, it is not recommended to start a survey project from controls derived from a particular road and close on controls that have been established from a different road, due to the possibility of having unacceptable misclosures. In Dar es Salaam, misclosures of about two meters have been observed in

certain areas. This may translate to a fraction of a millimeter on a 1:2500 base map, but unacceptable for cadastral survey by the Director of Survey.

Land survey and demarcation within Dar es Salaam. The procedure for demarcating and allocating land begins with a request for a planning scheme by the city planner. A request is made for a base map (1:2500 map) of the area to be planned from the surveys section of the council. The base map is updated by the town planners using steel tape and compass. The proposed layout is done on the updated base map. This becomes the town planning drawing. After the town planning drawing has been prepared, the Urban Planning Committee reviews the design and recommends whatever changes that the committee might consider necessary.

The design is adopted when both the Urban Planning Committee and the city planner's office are satisfied. The drawing is then sent to the Director of Urban Development for approval. At the director's office, the drawing is taken through the normal checking procedures, including ensuring that the design conforms with the land use scheme as shown in the master plan of the area. Once the design has been accepted as conforming with the master plan, the drawing is approved by the director on behalf of the Minister for Lands and returned to the City Council for implementation.

The land surveyors at the City Council demarcate the land according to the design. Survey field sheets, computation sheets, and a list of the coordinates are sent to the Director of surveys and mapping for checking. The office of the director of surveys checks the

quality of the reference controls that were used for the survey, the method of survey, the computations, and the misclosures of the traverses.

If the results are within the required standards of accuracy, then individual plot numbers are assigned. Otherwise, the drawing is returned to the city land surveyor's office for a resurvey. Having assigned unique numbers to all the individual lots, copies of the plan are distributed to various departments, including the city planner, city land surveyor, and the city lands officer. The city land surveyor's copy is used to update the 1:2500 standard sheets that are maintained in the office. Another copy is archived for future reference. The copy that goes to the city lands officer is used to allocate the plots to applicants.

Land allocation. In Dar es Salaam, allocation of plots is done by the Urban Planning Committee. The copy of the subdivision plan that is sent to the Commissioner for lands is meant to serve, among other things, a notice to the fact that the parcels have already been allocated. Sometimes the notice gets delayed to the extent that the commissioner's office inadvertently allocates that same plot to other applicants. Genuine mistakes of this kind are easily noticed when the owners commence registration of the certificate of occupancy.

Requests for land under Certificate of Occupancy may be submitted to the district land officer or the city lands officer. Requests received by the district lands officer are forwarded to the city lands officer. All requests are compiled by the city lands officer and submitted to the Urban Planning Committee. The Planning Committee meets to allocate the plots to the applicants. Allocation is supposed to be done in the order in which they are

received (i.e., on a first come, first served basis). After the committee has made the allocations, the city lands officer requests an assessment of each of the newly allocated parcels.

Upon receipt of the assessment information, the city lands officer prepares letters of offer and sends copies to each of the applicants whose request was approved. The letter of offer contains the terms of the offer, the fees that need to be paid, and the time within which to pay the required amounts. Each letter of offer is prepared in quadruplicate. The original goes to the applicant and copies sent to the commissioner for lands and the city lands officer. The last copy is kept in a file at the District Land Office where the letter was prepared.

The recipient normally has 30 days from the date of the letter to accept the offer and pay the relevant fees. After accepting the offer, the recipient also has three years to develop the plot in accordance with the intended use (e.g., by constructing a house on it).

Property Valuation and Rent Assessment

As mentioned earlier, it is the responsibility of the valuation section to assess the land rent. Assessment is done after an offer has been accepted. The land officer submits a request to the valuer for land rent assessment for each parcel of land before the letters of offer are sent to the applicants. As shown in Figure 4-4, the request for valuation is submitted in the form of a letter to the chief valuer who records the description of the property, the plot number, location of the property, the purpose of the valuation, and the date of the application. The chief valuer then passes the file to a valuation officer for action.

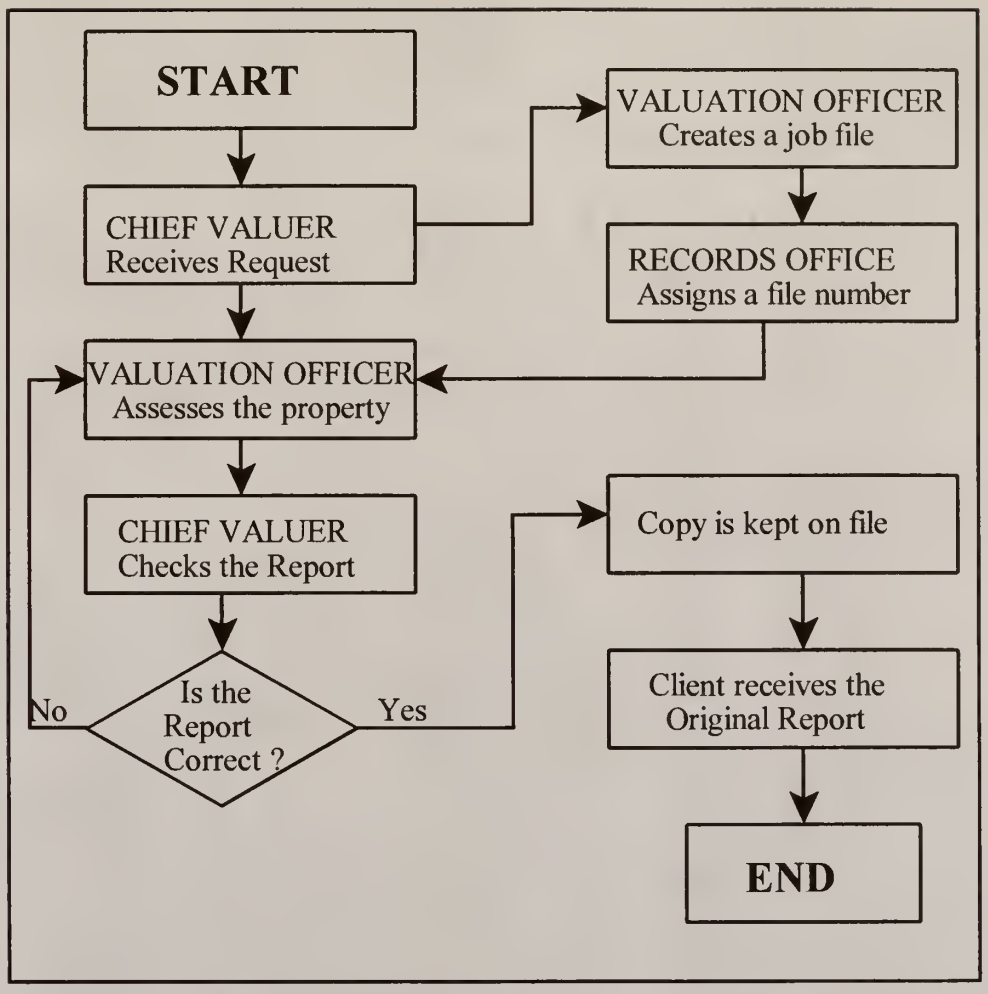


Figure 4-4: Schematic Diagram of the Procedure for Assessing Property

The valuation officer asks the registry section to create a file for the job. A valuation number is then assigned.

The file is returned to the valuation officer once a file number has been assigned. The valuation officer then schedules a visit to the site of the property and collects the necessary information. Subsequently, a report is written in which a value is assigned to the property. The report is submitted to the chief valuer for checking and approval. Unless there are

obvious mistakes requiring a return to the valuation officer for amendments, the chief valuer approves the valuation report. The fees for valuation are based on the assessed value of the property and the direct costs of trips to the site. Upon payment of the required fees, the report is given to the client and a copy is kept at the lands records office.

Certificate of Occupancy

The request for a Certificate of Occupancy may be presented by an individual, the regional land officer (in the case of requests from the regions) or the city land officer. This happens after the allocating committee has offered the plot of land to the applicant and the applicant has accepted the offer.

There is no way of knowing if the offer has been declined by the applicant. As a result of this flaw, there is no way of keeping track of the allocations that have been accepted and those that have been declined. The only way to find out about an offer that was not accepted is through the process of official search or if an interested party keeps track of the allocation.

As shown in Figure 4-5, the approval process for tha certificate of occupancy begins at the reception counter. The documents are first submitted to a receptionist at the reception counter who stamps a date to indicate when the documents were first received. The document is then sent to the open registry for a land division number. At the open registry, the documents are put in a folder. The folder is then sent to another office within the open registry (indexing room) where a unique land division number is issued to the folder. The plot number, block number, location description, and name of the owner are

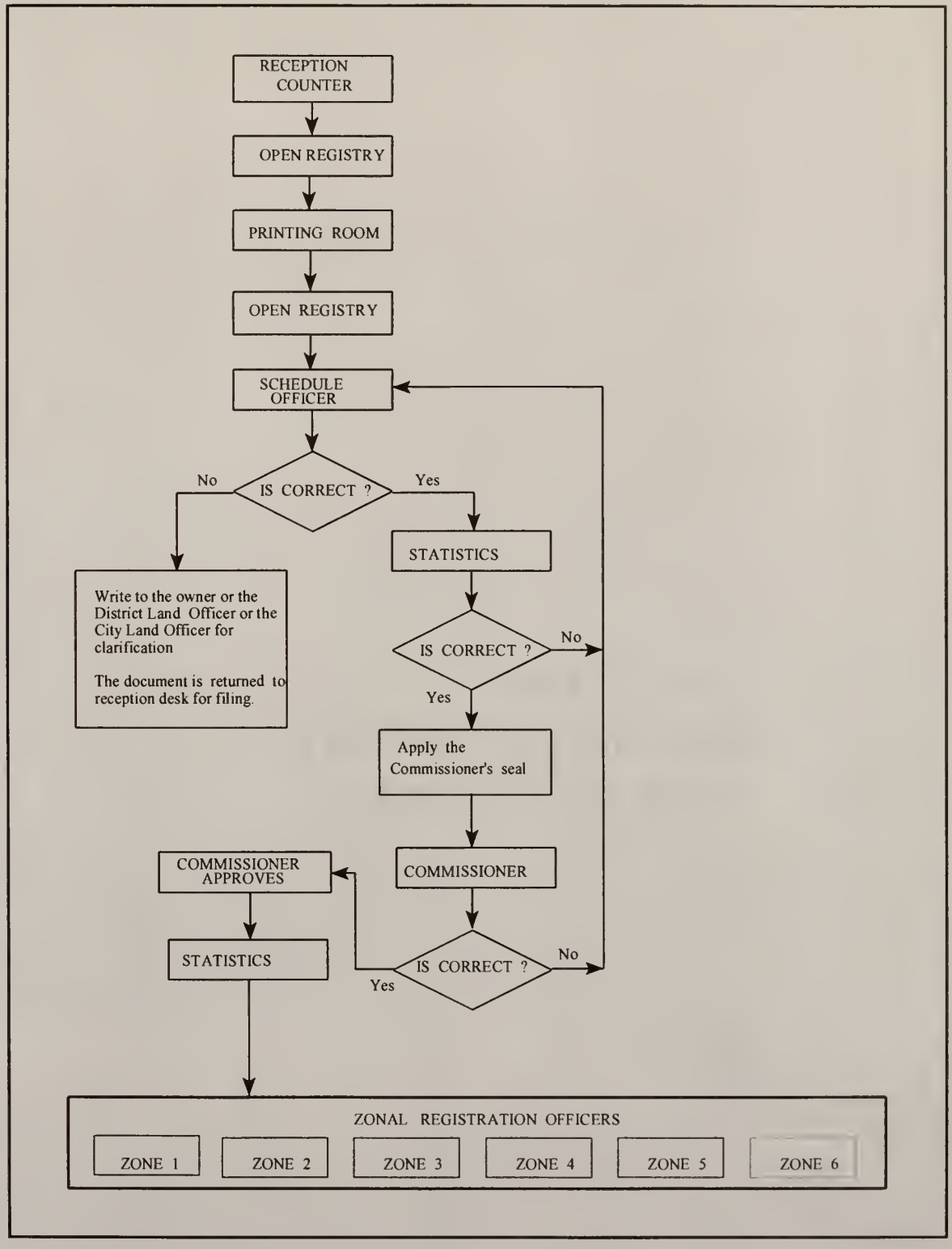


Figure 4-5: Land Office Procedure for Issuing a Certificate of Occupancy

recorded on an index card that is kept in the indexing room. The folder containing the document is sent to the printing section where the land division number and description are printed on the cover of the folder.

The folder is returned to the open registry again and given to the respective schedule officer. The folder is placed among other folders from the same region that are waiting to be processed by the schedule officer who is responsible for documents from that particular region. The schedule officer checks for ownership, letter of offer, advise of payment, evidence of payment of fees, correctness of the certificate, typography, and other relevant letters and documents are included.

In the case of farms, a check is made whether the respective land allocation committees from the village level to the regional level have all consented. If all the items are correct, then the schedule officer sends the folder to the statistics section. Otherwise the schedule officer writes a letter to the individual or the land officer who submitted the document and requests more information or explanation as to why the documents were submitted in that manner. Having written the letter, the schedule officer returns the folder to the receiving desk to be filed until a reply to the letter is received.

At the statistics section, the folder is checked again for any errors that the schedule officer may have missed. If a mistake or omission is found, the folder is returned to the schedule officer. Assuming that everything is correct, the technician at the statistics office takes the folder to the commissioner's office. The commissioner's seal is put on the document and the folder is left in the commissioner's office where the commissioner checks the document for any errors that the schedule officer and the technician from the statistics

section may have missed. If any errors are found, the folder is returned the statistics office for forwarding to the respective land officer for corrections to be made. If the document passes the commissioner's scrutiny, then the commissioner appends his signature. The folder is returned to the statistics section.

At this stage a copy of the document is retained at the land records office. Documents approved by the commissioner and returned to the statistics section are sorted according to zones. The twenty regions are grouped in six zones. The document is finally placed among those that belong to the same zone, either to be collected by the zonal registrar or be dispatched through official channels.

Registration of Certificate of Occupancy

Documents for registration may be submitted at the registration counter of the land registry, where a document begins its journey through the processes shown in Figure 4-6. The documents are stamped as having been received at the counter. An entry is made in the counter book as well, to indicate that the document was received. The counter is closed daily at 13.00 hrs. to give the counter clerks time to record all the documents received that day. The documents are deposited at the office of the registrar of titles before the end of each working day.

The registrar reviews each document the previous day and determines what needs to be done on each document. The documents are then distributed to the respective officers who need to work on the documents. Those to be registered are given to the staff at the

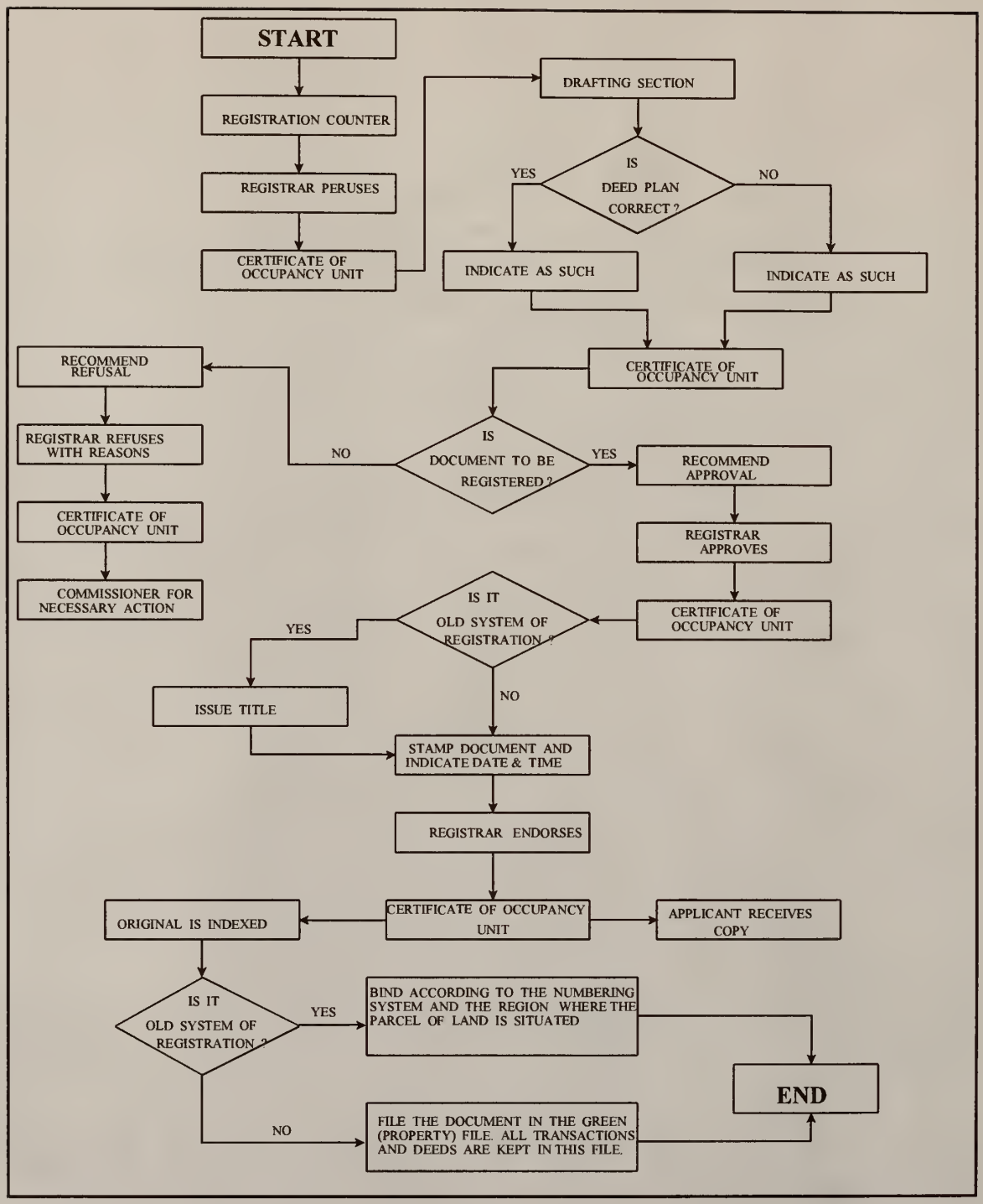


Figure 4-6: Procedure for Registering a Certificate of Occupancy

certificate of occupancy unit. The staff at the certificate of occupancy unit checks that the following procedures are complete:

- The stamp duty has been paid and that the correct amount was paid.
- The Registration fee has been paid.
- A unique land office number has been issued.
- The document has been signed by the commissioner.
- A land records property index card does not already exists for the property.
- The name of the owner has been written out in full (no initials accepted).

From the Certificate of Occupancy unit, the document is passed to the drafting section for the cadastral plan to be checked for errors and omissions. The observations of the drafter (whether the cadastral plan contained errors or not) are indicated on the document and returned to the certificate of occupancy unit.

Based on the results of the checks by the staff at the drafting section and those at the certificate of occupancy unit, a recommendation is made to the registrar indicating whether the document should be approved for registration or not. If documents are then returned to the registrar with recommendations for refusal, that recommendation is put in writing together with reasons. The document is the returned to the certificate of occupancy unit.

The certificate of occupancy unit passes the document to the commissioner's office along with the registrar's comment. At this stage, the commissioner decides whether to correct the errors or to return the document to the source for corrections to be made. After the corrections have been made, the document then has to got through the process all over

again. In order for documents that have been approved by the certificate of occupancy unit to be registered, the recommendation must be passed to the registrar and he gives the approval for the process of registration to begin. The document is then returned to the certificate of occupancy unit where the actual registration process begins. At this stage, if the document is for the old system of registration, then a unique title number is issued at the certificate of occupancy unit. All documents, whether under the new system or the old system, are stamped. The date and time of registration are indicated on the document. The document is then sent to the registrar's office for endorsement. After endorsement, the document is returned to the certificate of occupancy unit.

At the Certificate of Occupancy unit, a copy of the document is given to the owner and the original is indexed. What happens to the original document next depends on whether the document is to be registered under the "old system" or the "new system."

The old system. Under the old system, the details of the Certificate of Occupancy are entered into a Land Registration book. The book has columns for 'counter' date and time, date of registration, and title number, district, parcel description, and other columns. Documents filed under this system are numbered sequentially in accordance with the numbering system of the region in which the document parcel of land belongs, e.g. 43803, 43804, 43805, etc. The title number is sequential within the zonal area of the Registry. Other Registries may have their own numbering sequence. It is possible therefore, to have title number 43917MTW in Mtwara and 43917MBY in Mbeya.

The title number and the date and time when the documents were first presented are stamped on the back cover of the folder. The documents (in duplicate) are sent to the Registrar (for the third time), and the Registrar finally signs them. The documents are then returned to the Certificate of Occupancy unit where an index card is prepared for the certificate. The original copy together with all the supporting documents are filed away and the duplicate copy is given to the owner. The certificate of Occupancy is bound together with others from the sane region in numerical order according to the title.

The new system. The difference between the 'old' and the 'new' systems is that Chapter 334, section 30 of the Tanzanian laws stipulates the preparation of a register folios. Identical records are kept in either system, however, the documents are sent to the Registrar together with the folio. The registrar has to sign the folio too. The signed documents are sent to the Certificate of Occupancy unit where index cards are prepared. The duplicate is given to the owner and the originals are filed in the following manner. The Certificate of Occupancy together with the cadastral plan goes into a parcel file known as a "green" file. The certificates are filed in numerical order according to the title number (e.g. 186001/15, 186001/16, 186001/17, etc). The register folio is put into a binder along with folios in the sane block. The binders are filed in sequential order. All correspondence concerning the particular title are also filed by the title number in a correspondence file. This process makes it easy to locate material pertaining to those parcels stored under the "new" system.

An analysis on this study is given in Chapter 5. Organizational problems and concerns that were noticed in the divisions within MLHUD have been listed in Appendix C.

Following the discussion of the problems and concerns, approaches to reorganize the cadastral records within the Ministry are presented.

CHAPTER 5
CADASTRAL INFORMATION SYSTEMS APPROACH

Following the review of the land delivery arrangements in Tanzania, an analysis of the problems, concerns, and observations that were raised during the study is made in this chapter. Problems and concerns with the existing arrangements have been listed in Appendix C. However, recommendations for remedial actions and solutions to the problems are addressed in this chapter so that solutions could be included in the pilot study. Although some of the problems and concerns can only be addressed through institutional reform, most of the administrative bottlenecks can be removed by streamlining the document handling processes. Those problems that can only be addressed through legislation are mentioned here for completeness, since modification of legal instruments is the responsibility of the cabinet of the government of Tanzania. Problems that can be resolved through a modification of the document handling and data processing methods are addressed here and tested during the pilot project which is described in Chapter 7.

The legal cadastre is still the primary system for maintaining land registration in Tanzania. The type of data that are recorded, the completeness of the register, access and availability of such information to other government agencies, businesses in the private sector, as well as the public in general are all factors that can influence the benefits that can be derived from the cadastral information. The object of the research has been to prepare

the infrastructure to support the perceived increase in land-related transactions following the adoption of the land market policy. In order to develop a comprehensive cadastral information system, which is the ultimate goal of the government of Tanzania, the cadastral records have to be complete, accurate and up-to-date. As such, approaches are developed, in this chapter, for removing obsolete and inconsistent records from existing data and reorganizing the records in a manner that they can be exported into a computerized database. Procedures are then developed for adding new records to the database, and finally, an approach is developed for implementing a cadastral information system. Problems and concerns need to be addressed so as to ensure an efficient and smooth running system.

Important issues that were raised during the study of the Tanzania land delivery process have been summarized as follows:

- The base maps which are referred to as standard sheets are not updated regularly.
- There are not enough cadastral survey control points within the urban centers.
- Also any survey controls that were established as control extension should be submitted to the director of surveys for approval before they are used for subsequent survey work.
- National survey controls have been established at different times with different equipment and different methodologies, the result being that while internal consistencies of certain controls are within acceptable tolerances, the absolute position is not very consistent.

- Manual computation of survey data and manual survey drafting processes are time consuming and prone to human errors.
- Because infrastructure is not provided before allocation, bulldozer operators pass their vehicles through any convenient route to get to the parcel of interest destroying boundary markers in the process.
- Multiple allocation of the same parcel has occurred due to poor communication between allocating agencies and improper record keeping and checking mechanisms.
- There are areas within the Local Government Act (Chapter 113 of the Tanzania laws) and the Town and Country Planning Act (Chapter 378 of the Tanzania laws) that either conflict with each other or assign the same responsibilities to the Urban Planning Division and the City Council of Dar es Salaam.
- It takes too long for surveyed plots to get allocated.
- Current method for determining who gets allocated a plot leads to corruption.
- It takes too long to prepare the individual Cadastral Plans.
- Current procedure for allocating plots for low-density areas, commercial, large agricultural and large industrial projects interferes with the normal process for land administration by the local authorities.
- People neglect to pursue the process to obtain title.
- No mechanism for checking and enforcing the 30-day period within which people can accept or decline the offer of a plot.

- The three-years development condition in which land, once allocated, must be developed is not enforced.
- Revocation of certificates takes too long to process.
- It takes too long to locate documents in the Open Registry.

Discussion of Improvements to Current Cadastral Arrangements

In order to effectively reorganize cadastral information to serve the objectives of the government and other interested agencies, a review of the administrative arrangements to support cadastral records compilation was conducted. The review included the responsibilities of the agencies within the operational components (see Figure 2-1), the extent and effectiveness of the mandate which has been given to the agencies by the legislation under which they operate. The agencies in this case are the surveys and mapping division, the land office, the land registry, the valuation and assessment office and the revenue office. In Tanzania, the revenue office operates within the ministry of inland revenue, which is different from the Ministry of Lands, Housing and Urban Development.

The study of institutional arrangements included efforts by the government to encourage registration by reducing the distance that people have to travel to registration offices, as well as the costs involved such as transfer fees, stamp duty, and transfer tax that people have to pay when transferring or registering their property were also noted. Technical considerations included appropriateness of innovative graphical data capture technologies such as GPS, Remote Sensing and Soft-copy photogrammetric methods as opposed to survey control densification followed by traditional land survey methods.

It was important to recognize the concerns of the user community too. Concerns of the user community included the time it takes to execute a survey, the convoluted registration process, and the length of time it takes to obtain a title. In proposing an approach for reorganizing the cadastral records this research focused on approaches that will improve:

- cadastral management flow line by reviewing procedures for survey data processing, land delivery procedures, land registration, valuation and assessment
- land registration flow line
- data processing linkages between land allocation, titling, and registration so that a smooth flow is ensured
- data entry and checking procedures
- the entire land survey, land allocation, titling, registration, and compilation of cadastral information procedures to identify areas where delays are created so as to remove those bottlenecks in the new system.

Other considerations included the introduction of computerized data archiving within the system, and standardization of the data format within the system so as to ensure data integration between interested parties. Operational needs of the staff were assessed, which was followed by recommendations that were aimed at removing administrative bottlenecks and eliminating or minimizing technical problems. This assessment was done according to divisions within the Ministry of Land, Housing and Urban Development and are described below.

Urban Development Division

The responsibilities of the Urban Development Division have been described in Chapter 4. The responsibilities of this division complement those of the local councils by providing the guidelines for local councils to manage their resources and ensure proper land administration. While studying the activities of the Urban Development division, it became apparent that the Urban Development division has assumed a greater role than the legislation provides for, since it is the responsibility of the City Council to ensure that basic infrastructure such as roads and water are available to residents of the squatter settlements. It appears the responsibilities of the two ministries overlap with respect to control of development in Dar es Salaam in particular. This causes confusion in the execution of responsibilities by both agencies and sometimes results in misunderstandings over choice actions in land administration.

In preparing the layout for areas within the master plan, the existing procedure is to send the proposed layout to the director of urban planning for approval. The layout is checked to ensure that the land is being used for the purpose that has been indicated in the master plan. For areas not included in the master plan, the director of urban development demands that layouts be submitted for approval even though the Town and Country Planning Act does not stipulate so. While this requirement may be a mechanism for controlling the planning of areas without master plans, there really is nothing to check if the planning committee for that particular jurisdiction has accepted the layout. The delay caused by the checking procedure in Dar es Salaam would be removed if the regional town

planning officers are given the responsibility for approving the layout of areas within the unplanned areas.

Surveys and Mapping Division

It was mentioned in Chapter 4 that land surveying activities are regulated by National Council of Professional Surveyors, which is a statutory body. The study elucidated the fact that membership requirements of the council do not include any knowledge of the advances in the surveying technology beyond the use of a transit theodolite and a steel tape, although survey education in Tanzania includes subjects such as photogrammetry, GIS, remote sensing, computerized mapping methods, and GPS technology.

It seems that the objectives of the National Council of Professional Surveyors have not kept pace with the trends in the changing phases of the surveying profession. As such, the council has not modified the survey practice to include these evolving areas of specialization. The National Council of Professional Surveyors should encourage students to specialize in any of the evolving areas and become members of the professional body by modifying the membership requirements to include knowledge and experience in modern surveying techniques.

The Survey Regulations. The staff at the Surveys and Mapping Division, as well as private surveyors in Tanzania, are still operating with survey regulations that were written in 1957. The regulation stipulates positional accuracies for surveys conducted in the urban

areas and for rural areas. The stipulation places emphasis on survey methods rather than providing solutions to problems. With the use of digital graphical data in Geographic Information Systems and Land Information Systems, it is important to ensure data integrity by including metadata standards for digital survey data.

Quality of the survey controls. Good quality survey control points are essential for any form of cadastral information system. Over the years, cadastral surveys have been done for small areas at a particular time. In dealing with a cadastral information system, the volume of data for the system can be rather large. It is important to ensure that parcels that are contiguous on the ground remain contiguous both physically and mathematically. To achieve this, the surveys have to be tied to some unifying spatial framework. However, the need for survey control densification is obviated by the fact that GPS technology has reduced the need to have a network of accurately surveyed controls. As GPS technology is not commonly used in cadastral surveying activities in Tanzania, it is recommended that survey control points be established by GPS methods as an aid to continued use of existing technology as well as a transition to large scale application of GPS technology.

The idea of having survey offices at the regions is to reduce the work load at the Dar es Salaam office. However, the stipulation for the director of surveys to approve and endorse all survey control points before tying new surveys to them defeats the entire objective for establishing the regional offices since the approval process takes time. It would be better for the control survey work to be checked by the regional surveyor. It is recommended that instead of having the director of surveys check, approve, and certify all

survey controls, a survey control densification unit be established at the regions, who will be responsible for establishing survey controls within the regions. The team should be equipped with transportation, global positioning system units, total stations, a laptop computer, and all the necessary accessories. The teams will consist of qualified and experienced surveyors who will be able to establish the controls, perform all the necessary field checks and computations, and certify the controls upon the request of the regional surveyors. The results may be sent to the director of surveys for his records.

For the working environment of the Surveys and Mapping Division, it is recommended that:

- the Survey and Mapping Division invests in survey equipment for all the regions, preferably modern ones;
- adapt the survey practice to modern technology and define accuracy requirements with regard to economic viability of the survey rather than absolute numbers;
- store current maps, plans, and survey field data in atmospherically controlled environment;
- microfilm all old documents to make space for new ones;
- adopt a parcel referencing and indexing system that can be easily computerized, easy to implement, and unique for each parcel; and
- initiate a process to convert the standard sheets and base maps which are in paper format into digital maps.

In a fully computerized records management system, electronic scanning of the old documents would be a better option than microfilming. However, due mitigating factors such as to the amount of computer memory required to store all the scanned documents, the speed of computer processors in 1995, the low level of computer knowledge in Tanzania, and the lack of locally available computer hardware maintenance skills, it was more appropriate at that time to recommend microfilming of the documents.

Land Development Division

Most of the administrative problems associated with the land delivery process are in the Land Development Division (see appendix C). Duplicate allocation of parcels and poor record keeping were the biggest problems in this division of the Ministry. It was obvious during the entire study that one of the biggest problem that the government faced was insufficient surveyed land to meet the demand for allocation. As long as the demand for surveyed parcel exceeds supply, people who have the political power, money, or some influence would attempt to circumvent the established allocation procedure. For this reason, stringent methods for controlling the allocation and registration process should be adopted. A first step would be a revocation of the Government Notice 124 of March 22, 1963. In addition to this revocation, the authority to allocate parcels should be given to a single committee such as the Urban Planning Committee or the District Land Allocating Committee. This will minimize, if not eliminate, incidents of duplicate allocation of the same parcel.

The procedure for preparing and approving a Certificate of Occupancy has been described in Chapter 4 with Figure 4-5. In preparing the Letter of Offer, it is the responsibility of the Land Officer to specify the fees and the amounts that the applicant should pay. Upon payment, the advice of payment is taken to the Land Officer before the Certificate of Occupancy is prepared. The responsibility for ensuring the payment of the correct fees should belong to the land officer. When the document goes to the commissioner's office, the document is checked by a schedule officer, who is also a land officer. After that, the document goes to the statistics office to be checked. After all the checking processes through which the document passes, there is no reason to find mistakes such as underpayment of fees. Yet, the registrar's office has returned several documents due to reasons which could have been found at any of the four check points. It is the view that the statistics office is not performing any real function other than counting the documents that go to the commissioner for signature. The functions of the statistics office can be performed by the staff at the reception counter. The following recommendations are presented so as to remove bottlenecks in the document processing and record management procedures:

- The land officers at both the local councils and the commissioner's office should be responsible for ensuring that the correct amount has been paid to the revenue office.
- There should be responsible officers (Desk Officers), to whom the schedule officers report, who will be responsible for checking the work of the

schedule officers before they are submitted to the commissioner for signature.

- The seal could be stamped by the Desk Officer to whom schedule officers report.
- The statistics office should be removed from the certification process.
- After the commissioner has signed the certificate, a responsible officer (for example, the Desk Officer) should take the documents to the registrar's office where he/she will go through the documents with a responsible officer at the registrar's office. Those documents that do not contain obvious errors will be accepted. The others will be taken back to the schedule officer who worked on the document.
- A mailing and/or holding room should be created where documents that have been approved will be sent for despatching to the regions. This may be a temporary process until either the recommendation to establish a Regional Land Administration Officer is adopted or the responsibilities of the regional land development officer have been extended to include the approval of certificates. If this responsibility is extended, then documents will not have to be sent to the headquarters to be approved.
- Old documents should be microfilmed to make room for new ones.
- Important documents such as property files should be stored in an air-conditioned room.
- Documents should be kept in file cabinets.

- Checking and documentation of Certificates of Offer should be computerized.
- Records should be organized in a manner that they could be found when they are needed.
- A senior staff person should be responsible for the Open Registry, and control and movement of documents and files form the Open Registry. The officer should maintain a register for tracking the movement of files and documents.

The Registry of Titles. The operations at the land registry, where titles are registered, are extremely well organized. The land registry is know by other names as title office and title registry. For this research, therefore, the use of such names refer to the same office.

This is the only section where documents are easily found. A proper checking and recording system is maintained. Any problems in the registry section have evolved simply because the number of documents have increased to extent where they cannot be maintained easily by manual methods. With some modernization and computerization, the records will be easier to maintain. Recommendations for facilitating the registration process and records management are presented here as follows:

- The reception counter should be headed by a responsible member of staff who will be able to do a preliminary check on the documents to ensure that all the obvious mistakes such as signatures, correct amount of fees, and

other mistakes are corrected before they are accepted. This will avoid delays in processing.

- Only documents that pass the preliminary check should be stamped with date and time. In the future, this activity can also be computerized to eliminate human intervention.
- The checking process should be simplified by using a standard letter containing boxes which will be checked for missing items.
- The reception counter should be equipped with computers so that official searches will be done quicker.
- A computer would avoid the registration or unintended duplication of ownership to a parcel. Such errors would be noticed at the entry point.
- The reception counter should be partitioned to create a waiting room for people who are waiting for assistance. A queuing system should also be adopted to ensure an orderly process which avoids several people clamoring for the attention of the officers.
- For the same reasons why electronic scanning of documents was not the most appropriate option at this moment, old land related documents should be microfilmed to make room for new ones.
- A separate computer should be assigned for indexing all documents that are registered. On a regular basis the information from that computer should be used to check what is actually in the records office. This will eliminate errors.

- Cadastral maps should be converted into electronic format, either by digitizing or processing the data in some coordinate geometry software, for ease of reference.

Document Processing Improvements

An approach to limit human intervention, avoid duplication, and to ensure data integrity by introducing checks at critical stages during document processing is discussed here. Reduction in duplication of efforts and bottlenecks in document processing are also considered in this sub section. For example, entries for location, block number, and the parcel numbers, which are first made at the Surveys and Mapping division do not have to be repeated at the title and land registry offices if the records are communicated to those offices that need to record them. This is more applicable to new documents that are presented for processing. An approach for reorganizing existing records as well as new documents with special attention to surveying, allocation, titling, and registration are discussed. A streamlined procedure is described which eliminates the convoluted approach which existed prior to this research.

Cognizant of these requirements, a computerized cadastral data management system is presented in Figure 5-1. This figure represents the central focus of the computerized land records managements system which would provide cadastral information support for the land delivery arrangements in Tanzania. The figure depends for its efficiency and effectiveness on the ability to incorporate the recommendations and improvements that have been presented in this chapter.

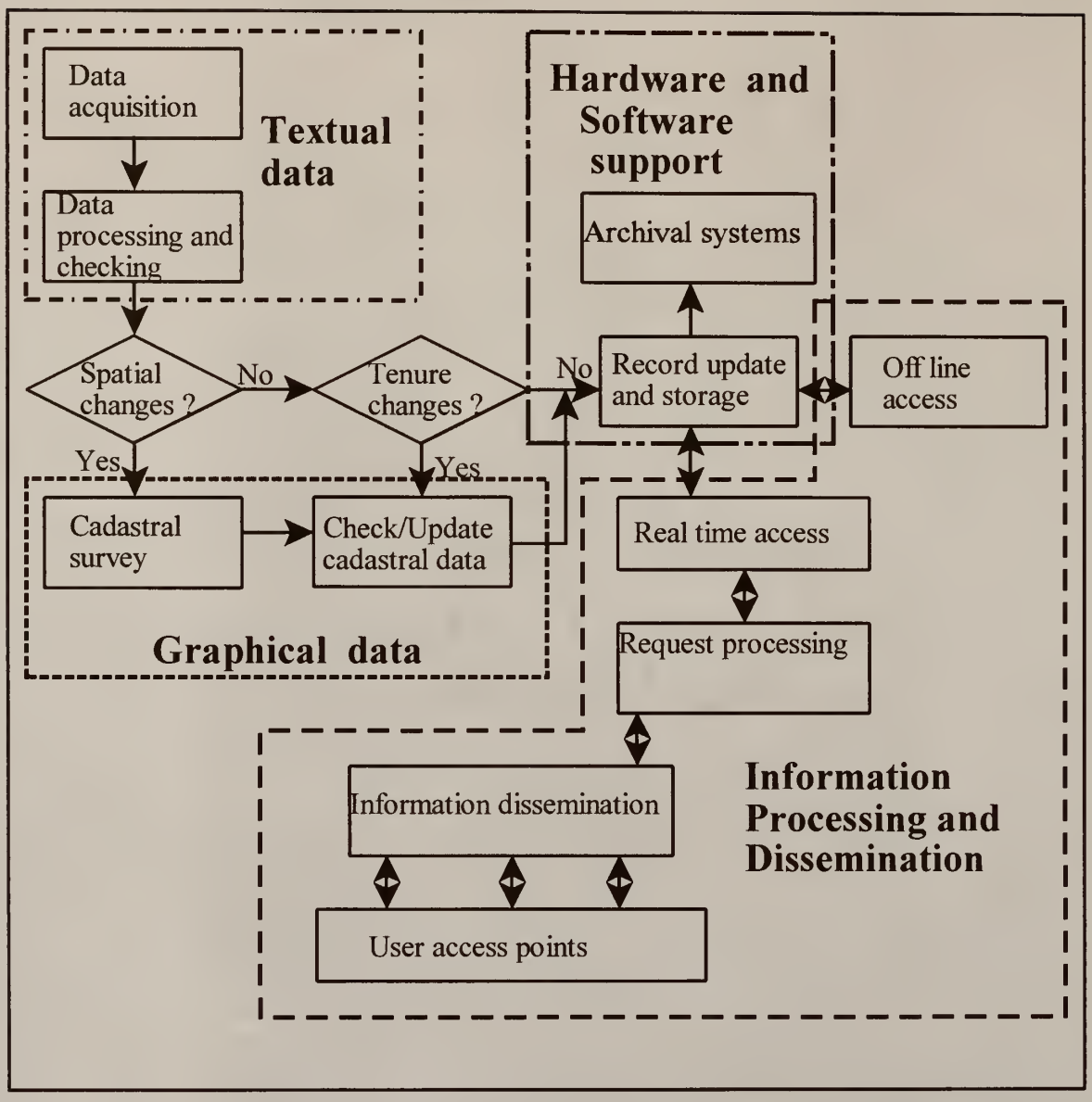


Figure 5-1: Computerized Cadastral Data Management System

In this figure, the need for update or addition of a record will be instigated by the presentation of a certificate of occupancy to be processed. If the transfer involves a change in the spatial extent of the parcel, such as a subdivision or amalgamation, then a surveyed cadastral plan is required. The graphical data component deals with the survey and checking

of the cadastral plan. The cadastral database is updated after the information on the cadastral plan has been checked. Change of ownership or and other descriptive information is made after the cadastral plan has been updated. Both the graphical and textual information are recorded into the hardware support component which includes hardware for data storage and archival, and software for data processing. The hardware support component is also used for storing historic data. For integration into other land-related information systems, the cadastral information system needs to be designed to provide both online and offline data access capabilities. Public access is also possible through terminals linked to real time access nodes. Data capture and processing procedures in Tanzania have been discussed in Chapter 4. Following this discussion on problems and concerns, practical procedures for improved document processing are presented in the next section.

Reorganization of Existing Records

An important criterion for implementing a functional Information System to support land administration activities is for the records to be complete. Whereas new records can be incorporated into the system during data processing, the importance of existing records for comprehensive querying and analysis should not be ignored. A procedure incorporating existing records into the system should be adopted. Some of the possible problems with existing land records in Tanzania are multiple ownership of the same plot (duplicate allocation), allocated but unregistered plots, transfer of ownership without proper documentation and plots with outdated ownership information such as owner's address. It is necessary to identify problems associated with current practices and to define procedures to

eliminate or minimize them. With regard to the land records, it is necessary to simplify the data capture, maintenance storage and retrieval processes without compromising accuracy or integrity of the data, and to organize the records in a manner that will ease the flow of information between various divisions within related agencies. A procedure for re-organizing and purging existing records of erroneous data is described below with reference to a diagram in Figure 5-2. Cadastral maps and plans should be digitized and assigned identifiers (subdivision numbers, block numbers, and parcel identifiers), producing a graphical data layer. The procedure for producing this graphical cadastral data follows the topological structure which is discussed later in this chapter. It is important to ensure that parcel identifiers are not duplicated.

i. Data from the land registry (also known as the title office) should be entered into the database. Internal consistency should be maintained to ensure that errors are not introduced. To avoid multiple registration of the same parcel, the database should be queried using descriptive location (from the textual database), block number and parcel identifier to identify parcels that have more that one legal owner except homogeneous groups of people such as families, communities, or organizations. Any plots identified this way would have to be isolated so that an adjudicating team may investigate and establish the legal owner. In Tanzania, where the state guarantees title, the aggrieved owner may have to be compensated for the loss.

ii. Data from the land office should be entered into the database, making sure that errors are not introduced into the records. Detailed description of the data types in any

particular record, are given later (in Table 6-2). Again, the database should be queried using location as identified in the textual database, district, block number, and parcel

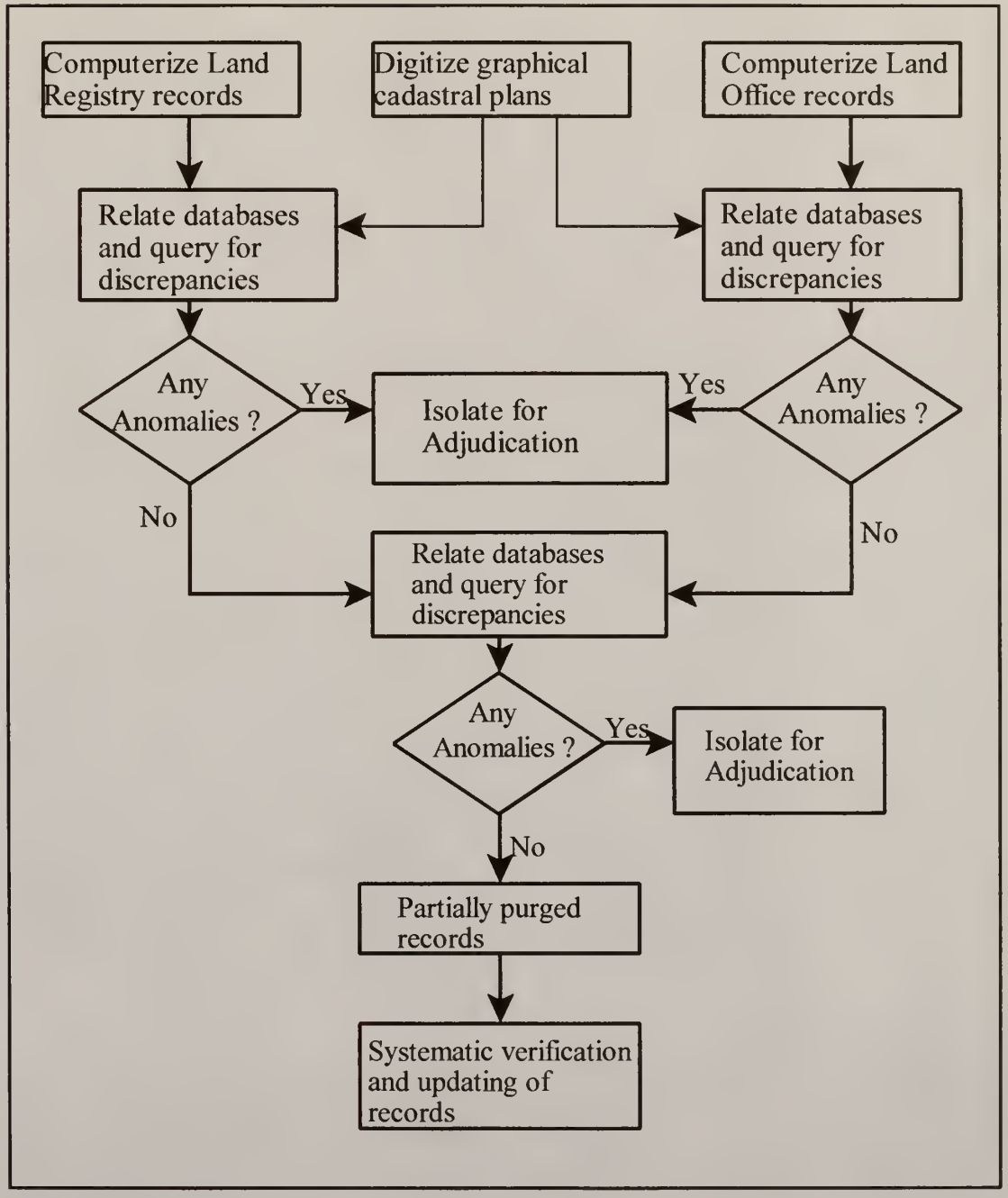


Figure 5-2: Procedure for Isolating Inconsistencies Among Existing Land Records

identifier to ensure that the same parcel has not been legally allocated to more than one person, family or organization. Any plots that violate this condition should be isolated so that the legal title can be established.

iii. Relating the computerized Land Office records with the computerized graphical data, query the databases to ensure that each record in the Land Office database has been referenced to a parcel in the graphical cadastral layer. Two possible errors may arise from this query; unallocated parcels and certificates without valid reference to the cadastral map. Since all parcels must be assigned by the allocation committee in accordance with the cadastral plan, it may be that those parcels were either not allocated or that the allocations were declined by applicants who failed to communicate their decision to the committee. Certificates that do not have valid ground reference may indicate the possibility of fraud. Any discrepancies should be isolated from the database and verified.

At this stage, each record in the Land Office database should be referenced to a parcel in the cadastral map. Remembering that the Land Office prepares the Certificate of Occupancy after the parcel has ben allocated and the Land Registry (or Title Office) registers the Certificate of Occupancy (the title) after the commissioner has signed and sealed the certificate, the record purging exercise is repeated with the records in the Land Registry.

iv. Textual records from the Land Registry (Title office) database should be related with the records in the graphical cadastral map. Using the location, district, block number, and the parcel identifier, discrepancies between the two records should be identified,

removed from the database, and resolved. Because Certificates of Occupancy that need to be registered are always referenced to the cadastral map before approval is given for registration, deliberate errors may not occur within the two databases. This condition was confirmed during the pilot study. The results form this query may comprise of parcels that have not been allocated and those that have been allocated but not registered. The next stage isolates the parcels that have not been allocated from those that have not been registered.

v. By relating the results from the Land Office query (step (iv)) and the Land Registry (Title office) query (step (v)), the records from the Land Registry database that are not referenced to the records at the Land Office would be the parcels that have not been allocated. The unallocated parcels should be isolated and verified before a decision can be made regarding the allocation. The final result indicates purged and partially accurate information with respect to legality of the allocation, uniqueness of the location, identifier, and the identity of the owner. However, the records are incomplete unless they are up-to-date in all respects. A schedule should be drawn for systematic verification of the currency of the ownership information, preferably by blocks. This process requires extensive education and public relation activities to educate the parcel owners on the importance of the exercise. An announcement should be made requiring owners of parcels within designated blocks to submit their documents for verification in accordance with the schedule. Upon presentation, the information in the documents should be checked against the entries in the computer. A current mailing address should be entered in the computer.

vi. Upon completion of this exercise, the existing records for the designated area can be regarded as complete and current.

Processing of New Documents

In the past, the practice at the Survey and Mapping division, title office and the land registry has been to accept all documents that are presented for processing. Whenever a document was found to be incomplete, processing was stopped until the owner submitted the missing details. The improved system seeks to address some of the problems that were hindering the progress of the previous system. It was important to streamline current processes by removing unnecessary procedures and ensuring efficiency without compromising either data quality or data integrity.

Considering that current land allocation and title registration processes have been in existence for several years, it was important that modifications be implemented gradually and systematically in order to confusion among the staff and perhaps total breakdown of the entire process. An important objective was to avoid introducing too many modifications into the existing processes to the point where the land allocation and title registration become a completely new processes for the staff to master.

Surveys Processing. The process begins at the Surveys and Mapping division with the newly demarcated and surveyed cadastral plan. The cadastral plan is submitted for approval, together with field notes and all survey computations. A general scheme of the approval process is indicated in Figure 5-3. In addition, the activities to be performed at

various stages in the new and improved system have been listed in Table 5-1. After the cadastral plan and the supporting documents have been checked and found to be complete, entries are made in the computer regarding date of submission and other relevant information.

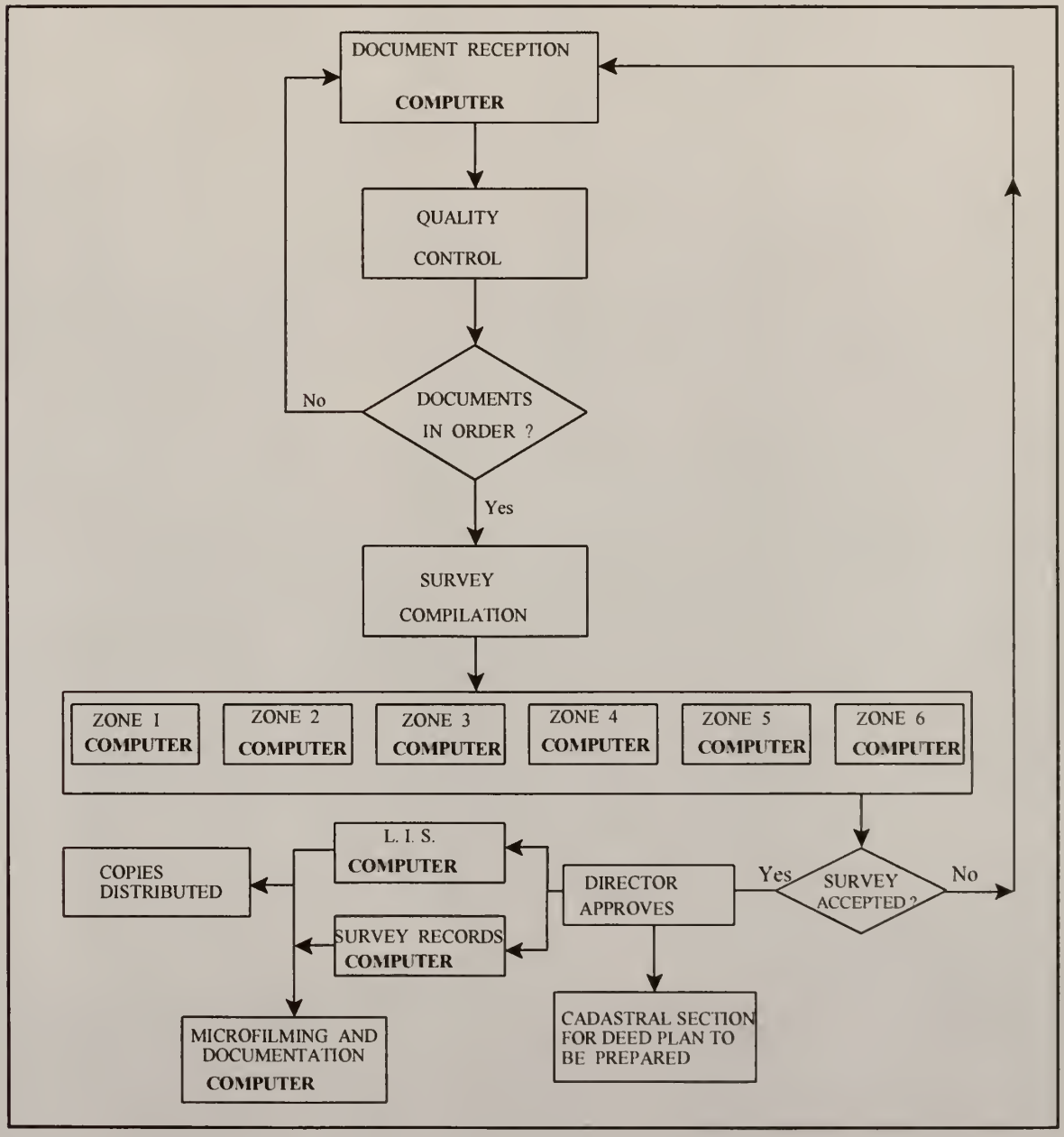


Figure 5-3: Improved Cadastral Survey Processing Procedure

The documents are submitted for quality checking. At this stage, the cadastral plan is reviewed for overall quality and neatness. The field notes are also reviewed for clarity and proper referencing. The next stage is a review of the compilation method, where the documents are checked with regard to the choice of survey controls that were used during the survey and proper documentation of any intermediate survey controls that were established.

Table 5-1: Cadastral Survey Processing Tasks

ACTIVITY	TASKS
Document Reception	1. Receive all in-coming surveys 2. Check to ensure that all supporting documents are included. Incomplete surveys or those without supporting documents must not be accepted. 3. Register the survey as confirmation of receipt into a computer. Incomplete documents that are returned should not be logged into the computer. 4. Pass the documents to the Quality Assessor. Notes: 1. The officer at this reception desk must be an experienced Records officer. 2. He/she should be familiar with the documents that are needed to support all new surveys that are presented for checking and approval and the supporting documents that are required when seeking approval for the acceptance of a newly established survey control. 3. He/She should be able to log the details of the survey into the computer.

Survey Quality Control	1. Check the quality of the job to ensure that it is worth processing. 2. That the job was done in accordance with the survey instructions. 3. The correct survey controls were used. 4. Acceptable angular closing errors were obtained. 5. Acceptable linear misclosure errors were obtained. 6. If in general, the work is of a professional quality, then 7. Pass the documents to the compilation officer. Surveys that do not meet quality specifications should be returned with written reasons for rejection. Notes: Preferably the quality control assessor should be a senior surveyor whose judgement on the quality of any survey will be respected.
Survey compilation	1. Receive the documents from the quality control officer. 2. Retrieves all adjacent surveys that have been done before. 3. Retrieves all previous computation files for adjacent surveys. 4. Retrieves all documents that have been referenced in the survey. 5. Puts all the documents together and passes the compiled documents to the examiner responsible for the zone in which the survey was carried out.
Zonal computing examiner	1. Re-do the computations by going through the same procedures that the original surveyor used. This duplication is necessary at this stage until the computation process is computerized. 2. At each stage, compare the results that are obtained with the original results. Documents that contain erroneous calculations should be returned with written comments. 3. Compare the final coordinates with those that were obtained by the original surveyor. 4. Return the documents with a written report giving reasons for rejection. If the calculations are OK, then 5. Produce a plot with the new coordinate values and compare with the original plot which was submitted. 6. If everything is correct, then recommend for the Director's approval.

L. I. S	1. Receive a copy of the approved plan from the Director of Surveys. 2. If digital data for the plan are available, then convert to an LIS readable format. Otherwise digitize the approved drawing and covert into an LIS readable format. 3. Attach plot numbers to the individual plots. 4. Merge the digital data with neighboring data. 5. Use the digital information to update the standard sheet. 6. Submit a copy of the digital data to the office of the Land Development Division so that the land Registry personnel would use to update their title records. 7. Submit a copy of the digital data to the office of the Registrar of Titles. 8. Submit a copy of the digital data to the Microfilming and Documentation unit. Notes: The person responsible for this activity should be a surveyor with a working knowledge in Land Information Systems. That person does not have to be a GIS analyst, yet have a very good understanding of spatial accuracy in a digital environment.
Survey records	1. Receive the final computed coordinates of the survey from the Director of Surveys. 2. Update the relevant databases that have been designed by the Land Records Specialist; vis a vis, jobs file, cadastral control file, geodetic control file etc. Notes: In addition to being a surveyor, the person who is assigned this responsibility must have a working knowledge about databases. He/She must have a working knowledge of database management systems.
Cadastral Plan section	1. Receive the approved master plan from the Director of Surveys. 2. Prepare deed plans for the individual plots. 3. Submit to the Director of Surveys for safe keeping.

Microfilming and Documentation	1. Receive the computations file from the Survey record section. 2. Microfilm the observation sheets and the final coordinate list. 3. Make two copies of each document. 4. Catalogue the documents by assigning unique numbers. 5. Enter the catalogued information into the computer. 6. Store the duplicate copy outside of the Ministry building. 7. Retain the original copy for reference at the Microfilming and Documentation unit. Notes: The microfilming and documentation unit is a new unit to be created. Persons selected for this job must be knowledgeable on Land Records Management procedures; microfilming, cataloguing, and archiving.

Finally, to ensure that the entire survey has been conducted in accordance with the survey regulations, the documents are then passed to the respective zonal officer whose responsibility it is to check the survey calculations and the accuracy of the final plot. Only documents which pass these checks are sent to the Director of surveys for approval. The Director's signature at this stage is just to complete the formality. The Director assumes that all the regulations and standards have been complied with. Upon approval, the cadastral map is converted into an electronic format and the requisite information are associated. Other information such as coordinates and description of any newly constructed survey controls are added to the appropriate databases. Copies of the cadastral plan and associated information are distributed to relevant offices. A copy of the cadastral plan is also submitted to the allocation committee.

Title Processing. It is the responsibility of the allocation committee to assign the parcels to successful applicants. After allocation, the list of successful applicants is sent to the title office where designated officers prepare the title for the signature of the Commissioner for Lands. After allocations have been done, processing and registering of titles are done at the Land Development office. As supporting documents are needed for each certificate that needs to be issued or registered, templates which contain checklist items that should be submitted with each document have been designed (see Appendix A). The improved procedure for processing documents at the Land Office is described below with the aid of the diagram in Figure 5-4. At the reception counters, each document that is presented for processing is verified to ensure that the required items have been included with the document before the document is accepted. Incomplete documents are immediately returned to the owner together with a copy of the template showing all the missing items. This action eliminates the delays which had characterized document processing activities at the Land Office. Documents submitted with all the supporting details are accepted and recorded into the computer at the reception counter. The entries would be used to keep track of the movement of the files. Entries at the reception counter may be used to analyze the number of documents that are received in a day, the number that have been processed or dispatched over a specified period, the number of titles that have been issued per region per year, as well as other statistical operations that would be needed on occasion. With computers at the appropriate locations within the system, the statistics section, which is the source of major

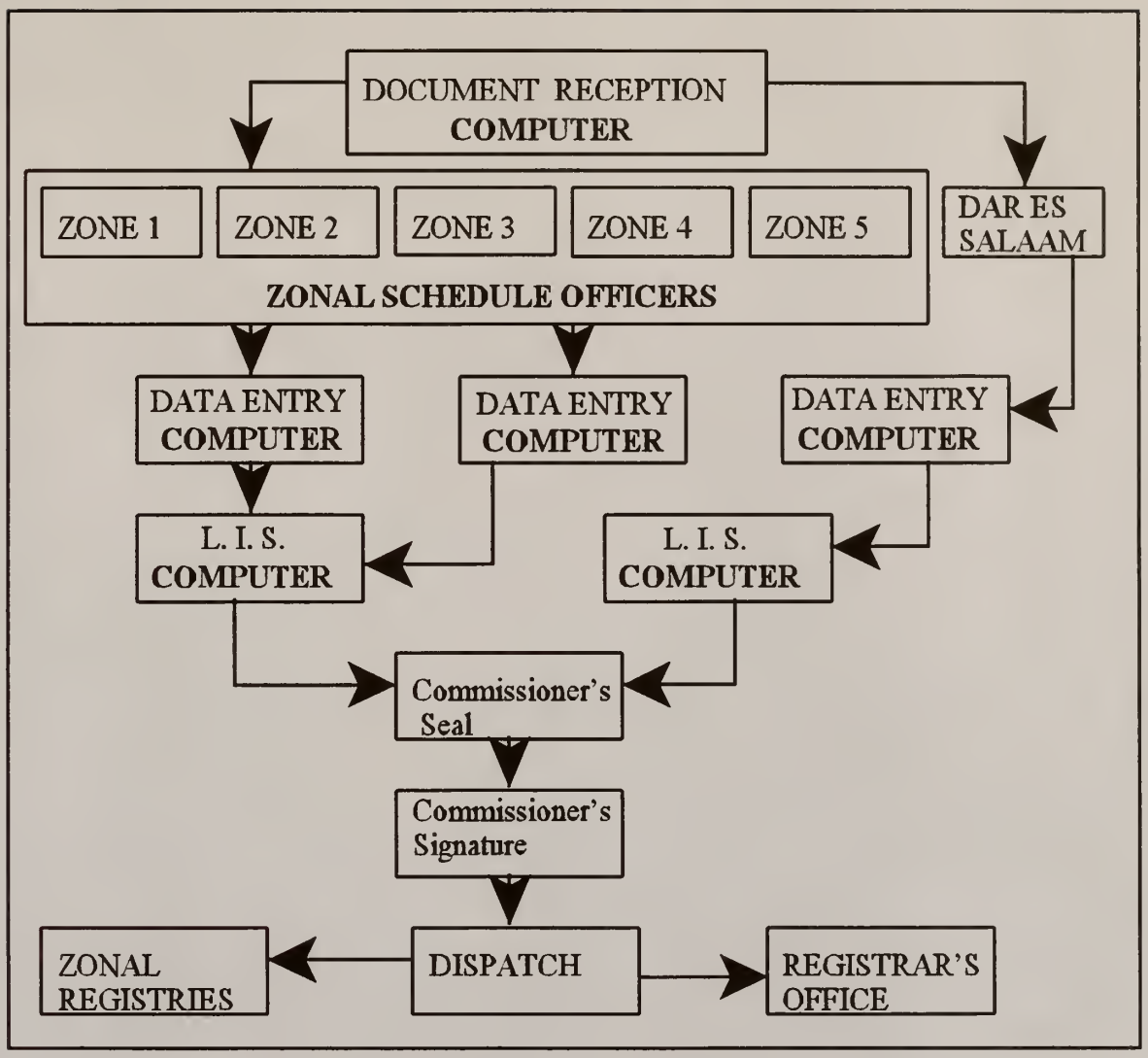


Figure 5-4: Revised Approach for Processing new Certificates of Occupancy

bottleneck, is no longer needed. The entries also provide the current status of every document that has been submitted for processing. Processed documents were again catalogued into the computer before they were dispatched to respective owners. Internal procedures for processing titles were also revised to ensure rapid processing, computerized documentation and easy tracking of documents. Responsibilities and activities at each of the stages in the Figure 5-4, are described in Table 5-2. As usual, the Commissioner signs the title

and it becomes official. Documents that belong to properties within the regions are sent to the assistant registrars in the zones. For properties within Dar es Salaam region, the prepared title and supporting documents are submitted to the Registrar's office for processing.

Table 5-2: Improved procedure for processing and Issuing Certificate of Occupancy

ACTIVITY	TASKS
Reception Counter	1. Receive files 2. Check that all supporting documents are included and are complete. 3. If O.K., log into computer and log book. 4. If incomplete, indicate missing documents on template and return to the person who submitted the application. 5. Place accepted applications in folders. 6. Pass folder to Schedule Officer responsible for the region. 7. If checking for documents, enter Land Office number and date, if available. It is also possible to search the database by name.
Schedule Officers	1. Receive folder containing application for title. 2. Check for payment of appropriate fees. 3. Check validity of the certificate. 4. Check that the parcel has not been assigned to someone already. 5. Enter data into computer if it is a new allocation. 6. Assign a Land Office (L-O) number 7. Print Land Office number on the folder. 8. Pass to LIS section.
LIS	1. Check the physical location of the parcel and ensure that it has not been assigned to someone already. 2. Associate data to the appropriate parcel on the map supplied by the Surveys and Mapping after ensuring that it is a new allocation. 3. Pass folder to the Commissioner's assistant.
Commissioner's Assistant	1. Apply the commissioner's seal to the title document 2. Keep folder until the commissioner is ready to sign the title. 3. The Commissioner's assistant should be responsible for assigning L-O numbers to the regional land offices.

The Commissioner for Lands	1. Receive documents for signing. 2. Review and sign the Title. 3. Pass the folder to Documentation section.
Document Archiving	1. Microfilm documents. 2. Catalogue microfilm and enter information into the computer. 3. Scan deed plan. 4. Submit digitalized deed plan to the LIS section. 5. File documents. 6. Store microfilm.
Dispatch	1. Log the date of approval of the title. 2. Log the method of dispatch into the computer. 3. Log the dispatch date into the computer.

Title Registration. With the title registration process, accuracy of data and the validity of the records are important. Checking the accuracy and validity of the data are the responsibilities of senior members of staff. In order to remove the delays that are caused due to insufficient information, it is necessary that the documents are checked at the entry point to ensure that any obvious omissions are corrected before the documents are accepted. Because several different types of documents may be registered at the land registry, each requiring different supporting documentation, there should be a senior member of staff at the reception, who is familiar with the registration requirements for all, or most of the documents, at the reception counter to check the documents against the requisite checklist before acceptance. Several other documents are processed there, including caveats, mortgages, power of attorney, etc. Each transaction requires different supporting documents. As such, different templates of checklists were prepared for registration purposes. It is imperative that documents that are presented for registration are thoroughly checked for legality, validity and

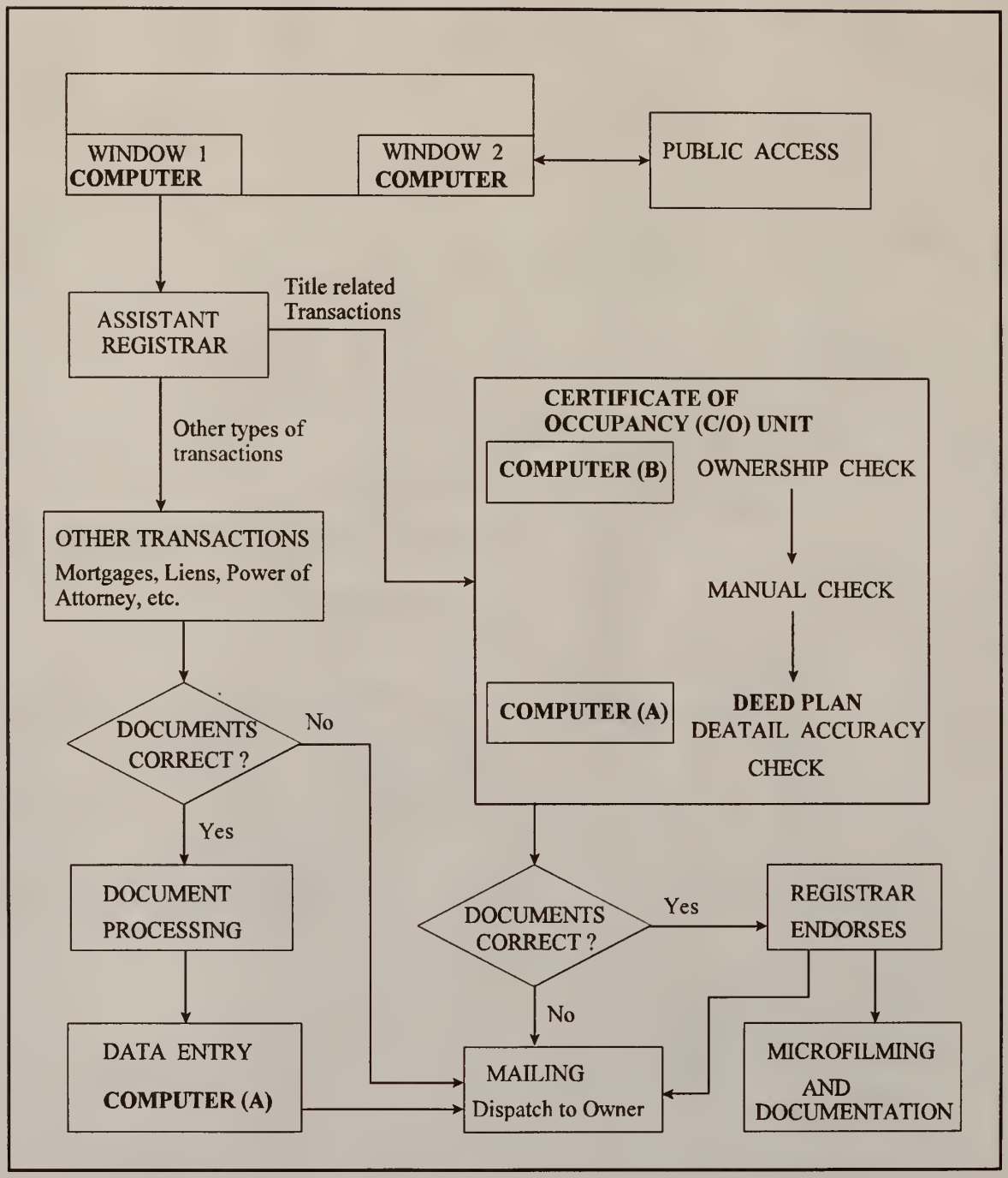


Figure 5-5: Improved Procedure for Processing Documents at the Land Registry

accuracy. Again, the objectives are to remove bottlenecks by streamlining the convoluted process such as a document being presented to the Certificate of Occupancy (C/O) unit four times during a single registration process. The schematic diagram of the title registration process is shown in Figure 5-5. Activities and responsibilities at various stages of the process are shown in Table 5-3.

Table 5-3: Document processing Tasks at the Land Registry

ACTIVITY	TASKS
Reception	1. Receive approved certificates. 2. Check that all supporting documents are included 3. Incomplete documents should be given back to the person who submitted them with an attached template showing all the missing supporting documents. 4. Documents that are complete should be entered into the computer. (This computer also contains status report of all documents, including dispatches). 5. Pass the document to the Asst. Registrar.
Asst. Registrar	1. Receive the documents. 2. Check what action need to be taken on the application. 3. Check that all supporting documents are submitted. 4. Incomplete documents should be returned to the mailing room with an attached template showing the missing items. 5. Complete documents should be passed to the appropriate section for processing. If document is for other transactions, pass to the appropriate personnel. If application is for title registration, pass to Certificate of Occupancy (C/O) unit.
C/O Unit	1. Receive the documents from the Asst. Registrar. 2. Check that the parcel has not been allocated already. If there is an evidence of duplicate allocation, retrieve that duplicate document and pass both documents to the Asst. Registrar for action . 3. Whenever fraud is suspected, the documents should be referred to the Registrar for necessary action. 4. If O.K. process document and pass to Deed Plan.

Deed Plan	1. Receive documents from C/O unit. 2. Check that the Deed Plan has been correctly and accurately drawn. 3. Check the quality of the cartography. 4. Check that the Block # , Plot #, North arrow, Scale, and description of the property agree with what has been recorded in the certificate. 5. If O. K. then pass to Computer A, else indicate what is wrong on the template and pass to mailing room. If in doubt consult the Assistant. Registrar.
Computer A	1. Receive document from Deed Plan . 2. Check from inside the computer that the spatial location of the Deed Plan is the same as has been presented on the Deed Plan. 3. Ensure that the same plot has not already been identified with different boundary markers. 4. Instances where fraud is suspected should be referred to the Registrar for appropriate action. 5. If everything O. K. then pass to the Registrar .
Registrar	1. Receives the document from the C/O unit. 2. Endorses the title and approves the registration of the title. 3. Pass the document to Registration unit. Note: At the C/O unit (Computer B) and the Spatial Accuracy (Computer A), Suspected incidents of fraud should be handled with all seriousness. Whenever there is sufficient reason to believe that fraud has been attempted, the Registrar should exercise his discretion to prosecute. In such situations, the documents should be passed to the legal section.
Registration Unit	1. Receive the documents from the registrar. 2. Register the title under whatever system that is appropriate. 3. Send original to mailing room(dispatch) 4. Send copy to Documentation and Archiving.
Legal Section	1. Receive documents and evidence of suspected fraud from the Registrar. 2. Investigate and recommend necessary action to the Registrar. The Registrar should make the final decision to prosecute. The Legal section should support the decision of the Registrar.

Mailing (Dispatch)	1. Receive registered documents from the registration section. 2. Log details of the title into the computer and Log book. 3. Send to the owner and indicate method of dispatch into the computer at the reception counter.

Entries are made into the computer regarding the ownership of the document and the date of submission. The document is then passed for processing. Besides checking for evidence of ownership, validity, and accuracy of information, checks are also made to ensure that the correct fees have been paid. Templates have been designed with a view to reduce the processing time (see Appendix A).

Documents with incorrect details are returned to their owners with copies of the template showing missing items and any incorrect data that need to be corrected. Properly prepared documents with evidence of payment of all requisite fees are entered into the appropriate databases. Again, after the documents have been checked against the appropriate template for necessary supporting documents, the next stage depends on whether the document is for a title registration or other transaction (see Figure 5-5).

The Assistant Registrar reviews the document to verify the type of registration that is required and passes it to the appropriate officer. For title registration, the officer checks to ensure that names have been entered correctly, and that the information provided corresponds with the information that was obtained from the Land Office (where the original certificate was prepared). A manual check is done on the deed plan to ensure that it meets the appropriate standard for registration. The next stage is to ensure that the parcel that is referenced does not belong to any other person. The parcel information is checked against the computerized cadastral plan to ensure its spatial location.

If the title passes all the checking processes, it is then sent to the Registrar for endorsement. Date and time of registration are then recorded. The records are then associated with the cadastral plan which has already been converted into a digital format by the Surveys and Mapping division. The Registrar of Titles then signs the title and the necessary information are recorded into the register. Signed titles are catalogued and sent to the zonal land registries. Copies of the document are retained for archival purposes. The owner receives a copy of the title.

Organization of Cadastral Information

Having addressed administrative, technical, and public concerns about the land delivery system in Tanzania, attention is now directed towards approaches for removing the bottlenecks in the land management process, and ultimately, for developing a cadastral information system for Tanzania. A cadastral information model, which is a component of a topologically structured multipurpose land information model (Figure 5-6), has been developed for Tanzania.

The topologically structured multipurpose land information model which is presented here, is based on graphical overlays that are constructed topologically. For example, the cadastral information support system component will have a topologically structured cadastral index map as an overlay. Other graphical overlays will be created topologically to support respective information system components. For example, topologically structured graphical overlays of road network and utility lines will be created to support the infrastructure information system component of the model.

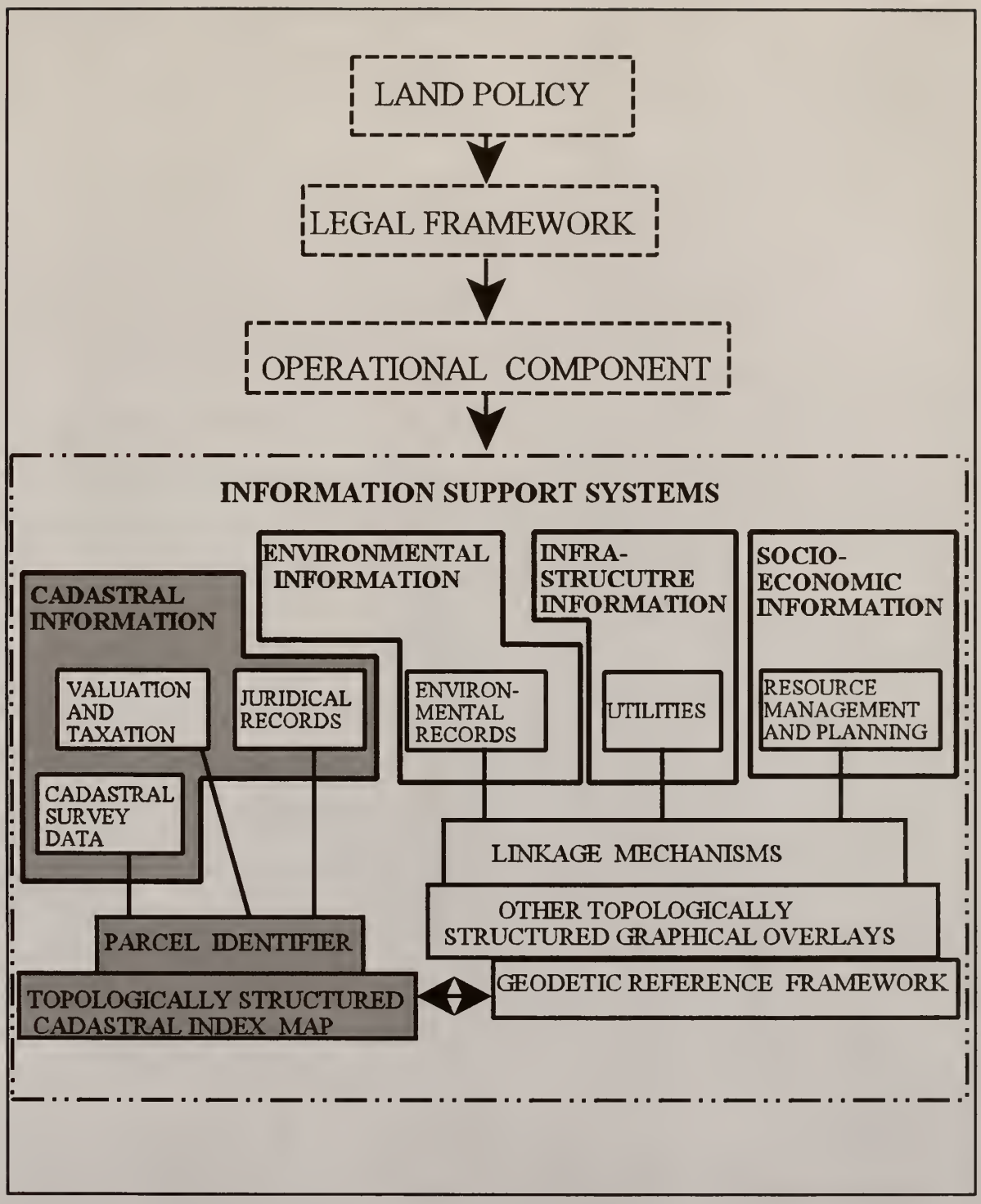


Figure 5-6: Topologically Structured Multipurpose Land Information Model

The topologically structured multipurpose land information model is developed from the perspective of the information support systems component of Figure 2-1 and on the fact that accurate base maps are not always necessary in decision-making situations pertaining to land management. While acknowledging the need for accurate base maps in certain land management activities, the expense for capturing the accurate data has always been weighed against the value of the land. In many developing countries with scant financial resources and competing economic and political projects, accurate base mapping is not always a priority (United Nations 1974; Dunkerly 1985; Holstein 1990).

A Cadastral Index Map (CIM) is a map showing a graphical index of parcels within a jurisdiction or a geographic region. Cadastral Index maps are used for administrative purposes and contain references to information such as ownership, value, and uses of the parcel.

A topologically structured cadastral index mapping approach presents a different way of looking at boundary delineation and base mapping as a whole, without the expense that normally accompanies such ventures. The model for the Tanzanian cadastral information system is distinct from other models that have hitherto, been developed with respect to the graphical data structure, the linkage mechanism, and constituent data within the system. Distinctive differences between the topologically structured model and the existing models which have been described in Chapter 3 are that:

1. Unlike the model for developing countries (Jeyenandan and Williamson, 1990), the topologically structured model is independent of the social grouping even though the distinction can be made from demographic data.

2. The four models described earlier advocate base maps in metric space, with relevant spatial accuracies. For example, the NRC model prescribes spatial accuracies as prescribed by the American Society for Photogrammetry and Remote Sensing, and the United States National Mapping Accuracy Standards. This model, on the other hand, relies on spatial relationships in topological space. However, in order to establish location in geographic space, the individual cadastral maps, which constitute the components of the cadastral index map, are tied together within a reference framework, which may or may not be geodetic in nature.
3. Unlike the existing models which have been designed to support existing government agencies, the topologically structured model is designed to support information types.
4. By defining the spatial entities as nodes, lines and polygons, attribute information can be associated with each of the entities. For example, by regarding the corner monuments as nodes, descriptive information such as the type of monument and individual identification numbers may be associated with them.
5. Accurately measured data in metric space can be associated with the topological entities. For example, accurately surveyed parcel boundary data can be associated with the parcel polygon, through its parcel identification number. This makes it possible for interested parties to access the accurate data and produce a true graphical representations of the parcels, if the need arises.
6. The topologically structured graphical overlay can provide a great deal of information without the expense involved in accurate survey measurements. For example, the cadastral index map can provide information pertaining to parcel ownership and

thereby, responsibility for tax liability, without the need know the exact boundaries of the parcel.

7. In places where accurate measurements of the individual parcels are not readily available, a topologically derived cadastral index map is an invaluable resource. The accurately surveyed information can still be associated when the data become available. Some land management activities can still be conducted without the need for accurate surveys.

In the following section, topological concepts are explained and the rules regarding the application of topological entities for cadastral index mapping, to support cadastral information system, are illustrated. The topological entities are defined in terms of the types of data to which the entities can be associated. The cadastral information system component is a subset of topologically structured multipurpose land information model.

Topologically Structured Cadastral Data Concept

In the computerized environment, procedures for representing graphical data are either the metric space or the topological space.

In metric space, the information are presented in three dimensional space using lengths (Croom 1989, 55), which may be derived from Cartesian or Euclidean space (coordinates, angles, azimuths and distances). Most land surveying measurements and calculations are performed in metric space. With different measuring equipment and methodologies, land survey computations always contain some imprecision due to measuring device, methodology,

or ambient conditions such as changes in temperature or topography. Additional procedures and sometimes statistical analysis are performed to reduce or eliminate the effect of such factors in measured quantities. The problem of imprecision in measures quantities due to measuring devices and procedures is eliminated in a topological representation.

Topology deals with geometric properties which are dependent only upon relative positions of the component entities and not upon such properties as length, size, or magnitude. Topology deals with properties which are not altered by continuous transformations like bending, shrinking and twisting (Croom 1989, 1). As a mathematical procedure for representing spatial relationships, topological principles are applied to spatial entities by defining them in their basic forms as points, lines and areas and establishing relationships such as adjacency (contiguity), connectivity, and areas among them. The concept of topologically structured graphical overlays is adopted in this dissertation, as the underlying structure of the graphical component of the multipurpose land information model that was developed for Tanzania. The topologically structured land information as applied to Tanzania is described in the next section however, the principles and application are given here.

By applying topological principle to vectorized cadastral plan or map, the spatial entities can be defined as nodes, lines, or polygons (areas). It is therefore possible to establish relationships, such as adjacency, connectivity, and polygon definition among the entities.

Node features. For this research, a node is defined as the intersection or meeting point of two or more lines. It is also the starting or terminal point of a line. In cadastral mapping

environment, a node will be the intersection of two or more boundary lines. Such intersections are normally identified by corner monuments. The corner monument of the parcel may therefore be regarded as a node entity. Attribute information can be associated with that node. Such information may be the type of monument, its location within a geodetic reference framework, identification number, list boundary lines that are radiating from the node, etc.

Linear features. Lines are spatial features which are too narrow to be represented as areas. In topology, linear features are considered to have beginning and end points. The terminal points are referred to as nodes. In terms of a cadastral plan, the linear feature is the boundary line, and the terminal nodes are the corner monuments. If lines, in topology, have starting points and end points, then a line can have a direction, a left side and a right side. By analogy, a boundary line, in topological terms, has a starting point, and end point, and a direction. As a topological entity, attribute information may be associated with the property boundary line such as, type of boundary marker (for example, a hedge, brick wall, or wooden fence), identity of adjacent parcels, type and identity of the monuments at the terminal points, etc.

Polygon features. Polygons, in this situation are the actual parcels. A polygon or an area is obtained if a line, such as a boundary line, completely surrounds a homogeneous feature such as a parcel. When such line surrounds the feature and terminates at the same

starting point, an area or polygon is formed. Examples of polygons include land parcels, forest stands and subdivision blocks.

In the next section, topological principles are reviewed. Procedures and rules for applying topology to cadastral mapping are presented. These rules are then applied to a pilot study for producing a cadastral index map for Tanzania.

Topological Rules and Cadastral Index Mapping

In dealing with geometric features, certain rules have to be applied. These rules define how topology is generated from the data that are presented. Due to the importance of cadastral boundaries, these rules have to be applied carefully to ensure proper definition of the geometry of cadastral boundaries that have been generated topologically. In this section topological rules and hierarchies of entity definition as are applied to this research are presented.

Node snapping rule. The position of the first node to be entered takes precedence over subsequent nodes. This defines a node-to-node precedence.
This means that if a node is created within a defined proximity from a pre-existent node, the second node should snap on to the first node (see Figure 5-7). For this research, boundary situations are considered positive. For example, a node that falls exactly on the boundary of a snapping region is considered to be within the region.

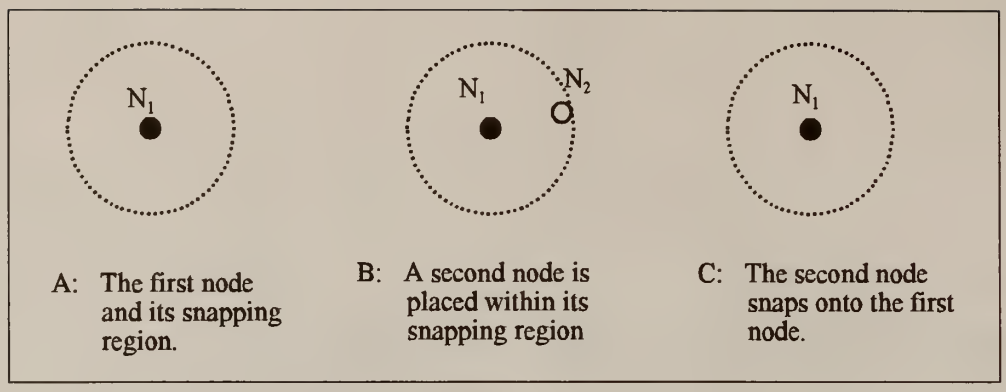


Figure 5-7: Node snapping precedence rule

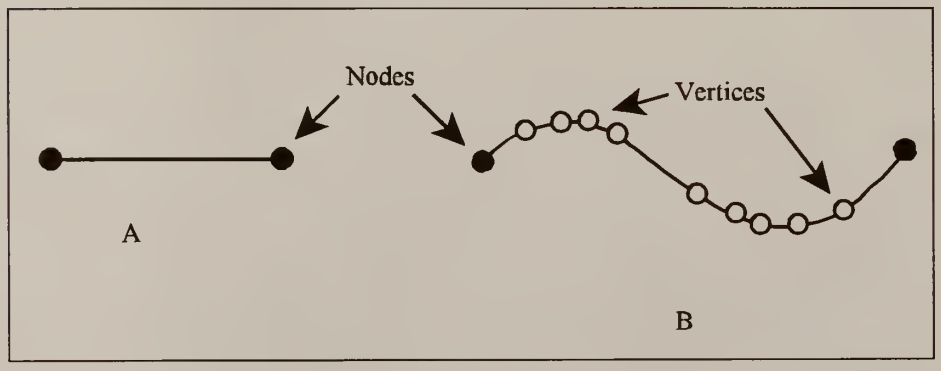


Figure 5-8: Two Definitions of a line

Line (Arc) definition rule. A line (arc) is made up of two nodes which define the terminal points and, in addition, may contain zero to any number of vertices (see Figure 5-8).

Minimum line definition rule. A line should have a length greater than the node-snapping distance in order to be retained topologically.

Node-Vertex precedence rule. The position of a node takes precedence over a vertex. Therefore, if a vertex is within the snapping region of a node, the vertex should snap

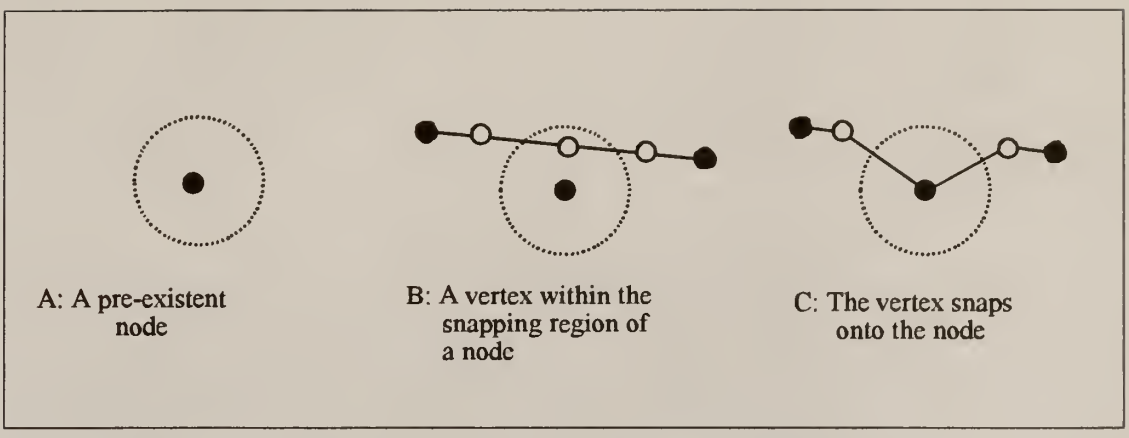


Figure 5-9: A node-vertex precedence

to the node (see Figure 5-9). This is illustrated in figure 5-9, where a pre-existent node is shown in A. A line a drawn with one of its vertices falling within the snapping region of the node, as shown in B. The vertex snaps onto the pre-existent node as shown in C, during the generation of topology.

Node-Line (Arc) precedence rule. If a line falls within a defined snapping region of an existing node, the line should snap to the node (see Figure 5-10).

This is explained with reference to Figure 5-10. The situations A or B occurs when a line falls within the snapping region of a node. In both cases the line snaps onto the node. A typical situation with respect to cadastral mapping is depicted in C, where a right of way exists between two neighboring parcels. As the nodes are within the snapping regions of

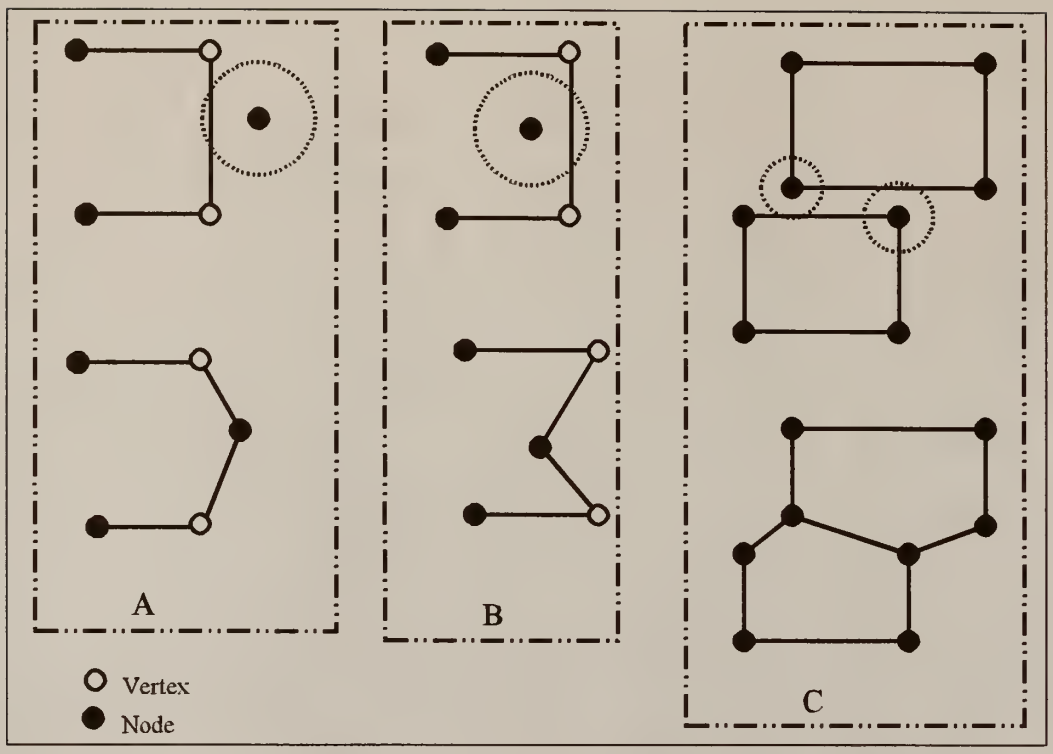


Figure 5-10: Node-line precedence

neighboring boundary lines, the lines snap onto the nodes. Two adjoining pentagonal parcels are formed instead of two neighboring rectangular parcels. To avoid such situations during topological mapping of cadastral parcels, snapping distances have to be set with caution.

Line intersection rule. If two lines cross each other, a node should be placed at point of intersection (see Figure 5-11).

In Figure 5-11A, the lines 1-2-3 and 4-5 cross each other. By rule, a node should be placed at their intersection point. The node precedence rule takes effect after the new node has been placed in position. If the new node is outside the snapping region of any of the pre-existent nodes. The final result is shown in B. Supposing that the line 1-2-3 was the first to

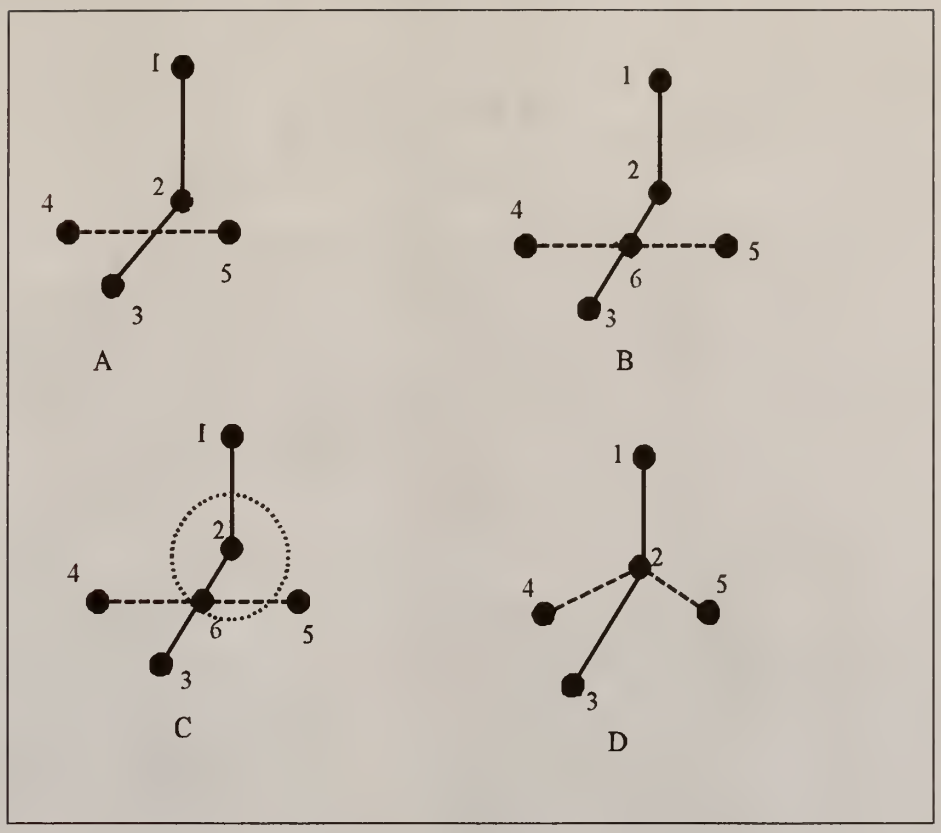


Figure 5-11: Node precedence after a line intersection

be entered, and the new node is within the snapping region of node 2, as shown in C, then node 6 snaps into node 2, as shown in D.

Vertex snapping rule. When two vertices are within a certain proximity from each other the second vertex should snap onto the first vertex. This rule also define line snapping (see Figure 5-12).

In Figure 5-12, the two lines are so close that some vertices fall within the snapping regions of other vertices. The affected vertices snap together, nodes are placed at their intersection points, and part of the second line is removed.

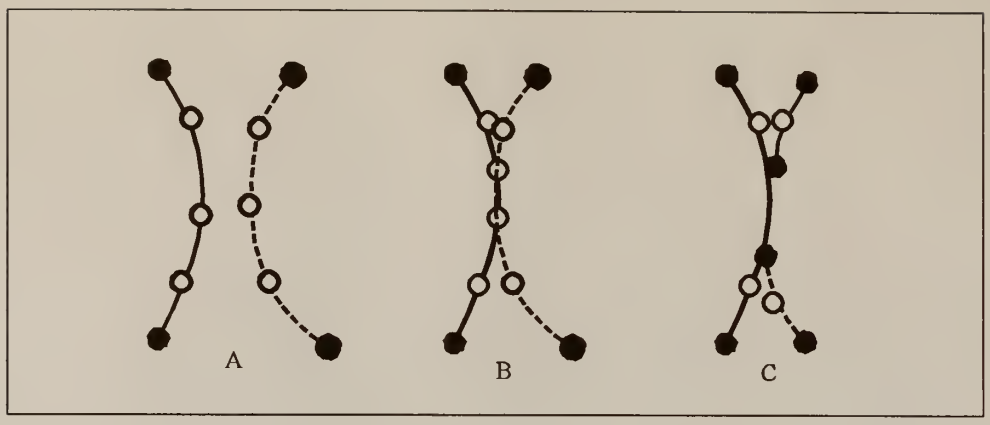


Figure 5-12: Vertex snapping

Application of the Rules to Cadastral Surveying

In cadastral surveying, boundaries are generally defined by the lines joining the corner monuments. This implies that the corner monuments have the highest integrity. As the corner monuments are represented by nodes, this means that by definition, nodes should have the highest level of importance. By the rules presented above, vertices have the lowest integrity, which can cause problems.

Unless otherwise defined, the line joining the boundaries should be rectilinear. A typical situation where curvilinear lines would occur in cadastral surveying is when the bank or center line of a stream is defined as a boundary of a parcel. Topologically, curvilinear boundaries would be defined with vertices and nodes at the terminal points. In cases where monuments have been established along the curvilinear boundary, those monuments are established as nodes during topological representation so as to retain their integrity.

Boundary Definition

Cadastral surveys begin with a survey of the external boundary and followed by the internal partitions. Topologically, the external boundary may be represented by a single line which begins on a node and closes on the same node, with vertices at intermediate corners (see Figure 5-13).

The situation represented as A, shows vertices as intermediate stations. This provides a poor representation of the external boundary, since the position of the vertices can be influenced by neighboring nodes and lines. In B, the boundary monuments are represented with nodes. This provides the highest integrity of the monuments. If internal partitions need to be drawn, those lines will begin as nodes and end as nodes. In A, the nodes of the internal lines will tend to move the vertices around. Movement of vertices will not occur in B since the nodes on the external boundary will have precedence over the nodes that define the internal partitions. Therefore, in order to have an accurate representation of the external boundary, the boundary monuments have to be represented with nodes.

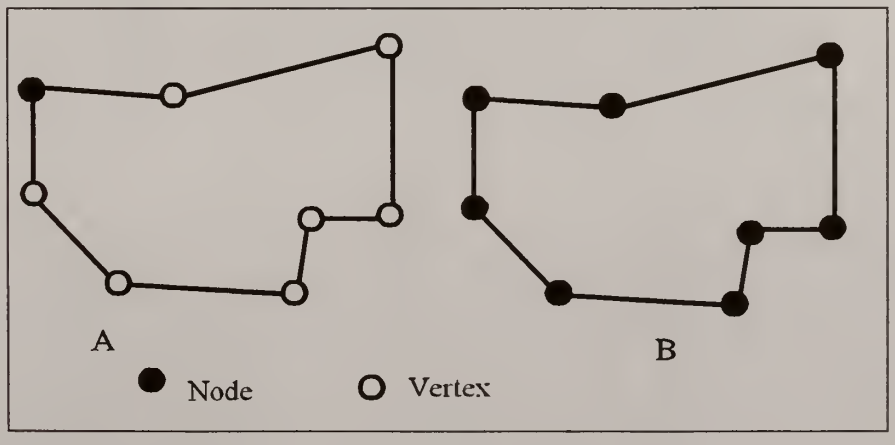


Figure 5-13: Two Topological representations of a Cadastral Boundary

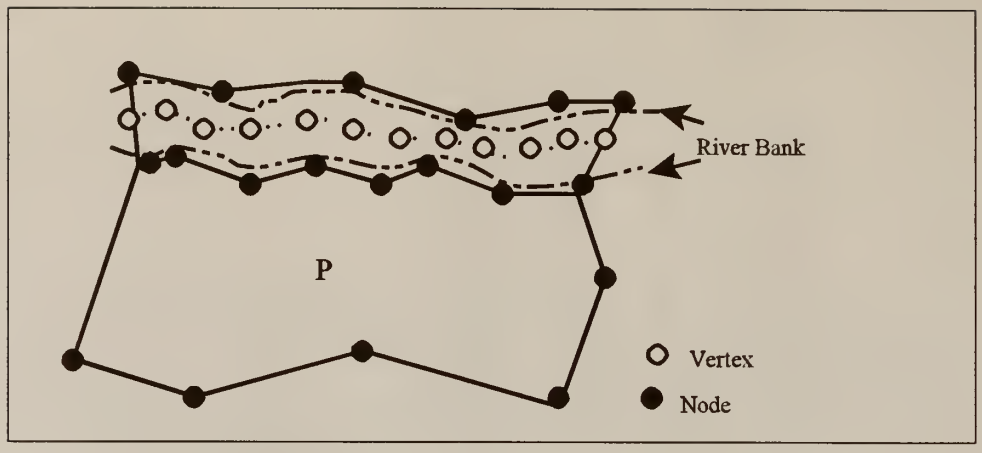


Figure 5-14: Representation of a Boundary with Vertices

A situation where a property boundary may not topologically be represented by nodes is when the boundary lies in the middle of a river (see Figure 5-14). In the figure, one of the boundaries of property A lies in the middle of the river. Since no precise measurements were made directly to the middle of the river, vertices are interpolated from mid-points between banks.

Subdivisions

Property boundaries in urban areas are generally rectangular in shape. For rural areas where parcels are irregularly shaped, partitions (or subdivision lines) need to be positioned precisely. As such, they have to be digitized as nodes instead of vertices.

Figure 5-15 shows a typical urban subdivision. Here, the corner monuments of the external boundary have been represented by nodes. In this Figure, it is assumed that no digitizing errors occurred at the terminal points of the line L_1, as shown in Figure 5-15B (highly unlikely).

Line L_2 extended over the boundary line but the boundary line was within the snapping region of the node. As shown in the Figure 5-15B, this condition caused the line to snap onto the node.

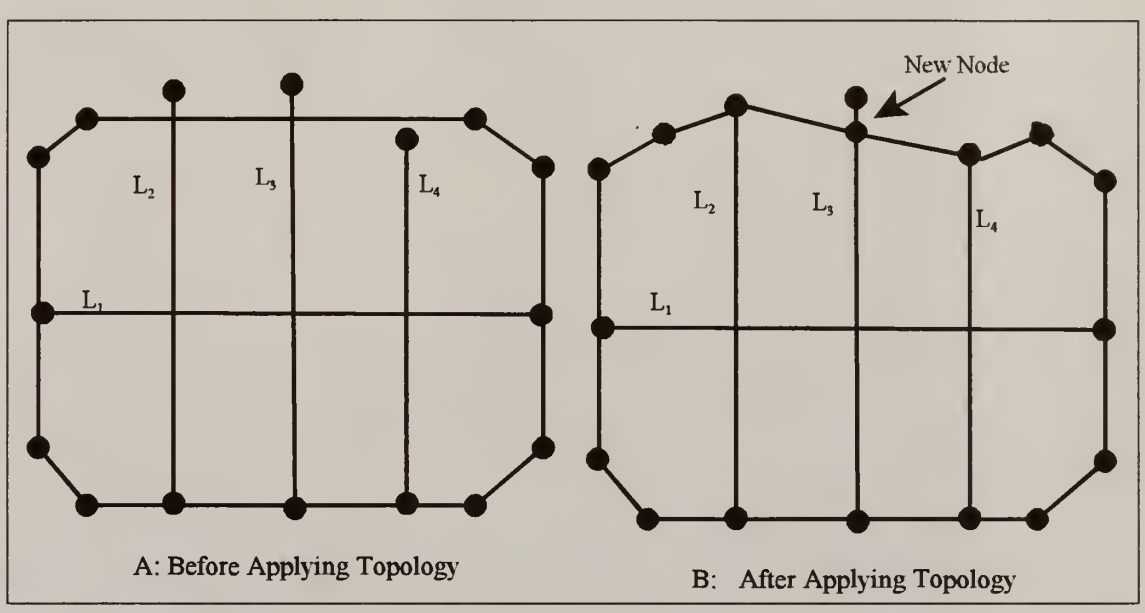


Figure 5-15: Topological errors in Cadastral Index Mapping

Line L_3 also extended past the boundary but the line was outside the snapping region of the node. According to the line intersection rule, a node will be placed at the intersection point of the two lines (see Figure 5-15B).

Lines L_4 fell short of the external boundary line. Again, the boundary line was within the snapping region of the node. Hence, the line was moved inward (see Figure 5-15B). These are possible scenarios that can occur during topological representation of cadastral parcels.

From these conditions, the rules for adequately representing contiguous cadastral parcels are summarized as follows:

1. Every point which is physically surveyed or accurately measured should be denoted by a node.
2. Snapping tolerances should be set as minimum as possible in order to avoid unwanted displacement of vertices.
3. It is better to have overshoots that are longer than the minimum allowable length of an arc. This will prevent unwanted snapping of nodes.
4. Removal of unwanted dangle lines should follow generation of topology.

These rules have been applied in the pilot study which is presented in Chapter 7.

Since topology involves non-metric relationships, measurement accuracies are not essential in topologically structured maps. This principle is applied in the compilation of a cadastral index map.

In situations where different parts of the jurisdiction have been surveyed using different equipment and different methodologies, and thereby, obtaining varying degrees of spatial accuracy in different parts of the map, topology provides an approach for tying the maps together. In its basic form, the cadastral plan consists of corner monument descriptions, boundary lines, the polygon which defines the parcel, and the label which identifies the parcel spatially.

Topological Rules and Principles Illustrated

An application of topology to the creation of a cadastral index map is illustrated by a situation shown in Figure 5-16, where three adjacent subdivision plans have been produced at different scales, in different coordinate systems , and different spatial accuracies. In the figure, the numbers denote the corner monuments and the alphanumeric characters identify individual parcels. The boundary line is defined by the line joining the corner monuments. By establishing topological relationships between the spatial entities, the three plans can be "joined" together. This is achieved by establishing point equivalence, line equivalence, line-to-node topology and polygon definition. Point equivalence is basically, used to identify nodes that are identical in the two plans. Similarly, line equivalence identifies lines that are identical in the two systems. Before the matching can be accomplished, one basic rule that needs to be established is that the location of a pre-existent point has priority over subsequent points. For

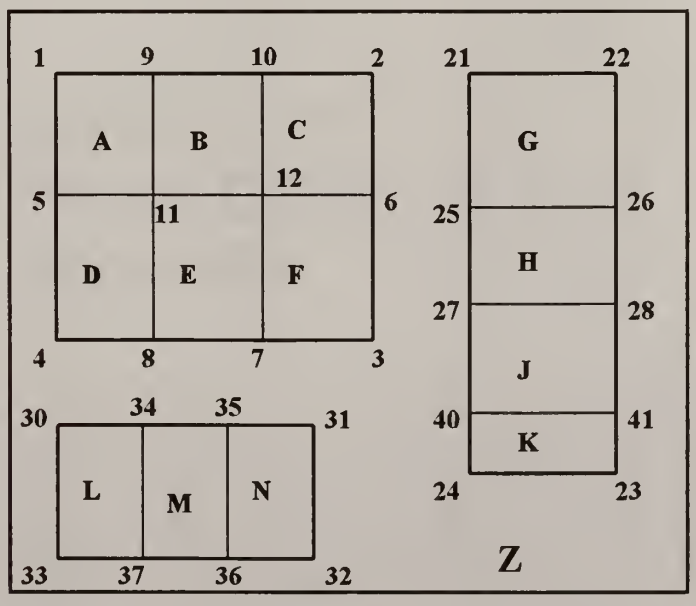


Figure 5-16: Three separate cadastral surveys

example, if a polygon needs to be added to the cadastral index map and the new polygon has two identical corners in the master cadastral index map, the new polygon will be enlarged or shrunk until the two corners match the pre-existent ones. Point and line equivalence tables for Figure 5-16 have been shown in Tables 5-4 and 5-5 respectively.

Table 5-4: Point Equivalence Table

Point number	Equivalent point numbers
2	21
6	25
3	27, 31
32	40
4	30
8	34
7	35

A line-node topology establishes connectivity between nodes and lines. This establishes direction, and therefore, the left and right sides of the line. The line-node topology for Figure 5-16 is shown in Table 5-6. A polygon-line topology identifies the lines which surround individual parcels to isolate them from one another (see Figure 5-16).

Table 5-5: Line Equivalent Table

Line identifier	Equivalent Line identifiers
2 - 6	21 - 25
6 - 3	25 - 27
31 - 32	27 - 40
4 - 8	30 - 34
8 - 7	34 - 35
7 - 3	35 - 31

Table 5-6: Line-Node Topology

From Number	To Number	Left Polygon	Right Polygon
1	9	Z	A
9	10	Z	B
10	2	Z	C
2	22	Z	G
5	11	A	B
11	12	B	E
12	6	C	F
6	26	G	H
4	8	D	L
8	7	E	M
7	3	F	N
3	28	H	J
33	37	L	Z
37	36	M	Z

36	40	N	Z
40	41	J	K
32	23	K	Z
1	5	A	Z
5	4	D	Z
4	33	L	Z
9	11	B	A
11	8	E	D
8	37	M	L
10	12	C	B
12	7	F	E
7	36	N	M
2	6	G	C
6	3	H	F
3	40	J	N
40	32	K	Z
22	26	Z	G
26	28	Z	H
28	41	Z	J
41	23	Z	K

Table 5-7: Polygon-Line topology

Polygon	Connecting Lines
A	1-9-11-5
B	9-10-12-11
C	10-2-6-12
D	5-11-8-4
E	11-12-7-8
F	12-6-3-7
G	2-22-26-6
H	6-26-28-3
J	3-28-41-40
K	40-41-23-24
L	4-8-37-33
M	8-7-36-37
N	7-3-40-36

After applying the topological principles and rules, the final product depends on factors such as the RMS error that was obtained after the transformation, digitizing errors, node snapping tolerance that was set, and methods for applying the rules to the nodes and vertices that were digitized. Figure 5-17 shows two hypothetical results of Figure 5-16. Results of the pilot study have been shown in Chapter 7.

Distortions have occurred for two main reasons. Firstly, through the affine transformation, and secondly, by constraining the nodes and lines to maintain their defined

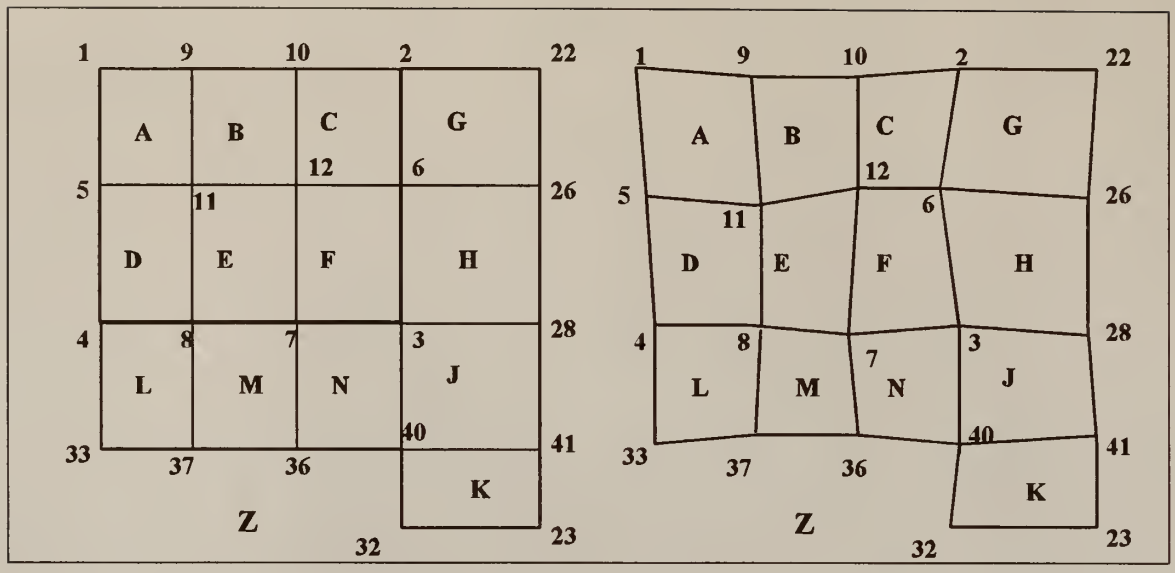


Figure 5-17: Two Topologically structured cadastral index maps of the same area

relationships. However, these distortions are secondary, provided the spatial relationships between the individual parcels are maintained. The question arises as to the accuracy of the map in metric space. Again, if the individual maps have good spatial accuracy, then the resulting cadastral index map would have good spatial accuracy. As an index map, the actual field survey measurements and the individual survey plan can be associated with the index map. Association can be achieved through linkage mechanisms such as a parcel identifier. The file containing the actual survey records can be accessed with the parcel identification number. Another advantage of this approach is the fact that attribute data can be associated with the corner monuments, the boundary line, and the parcel independently.

The procedure for developing a cadastral information system for Tanzania , including the creation of a topologically structured cadastral index map is discussed in Chapter 6. The

distinction between the cadastral index map in metric space and the same map in topological space is also clarified in Chapter 6.

CHAPTER 6
CADASTRAL INFORMATION MODEL FOR TANZANIA

Information system components for land management have been described in Figure 2-1 (in Chapter 2) as cadastral, socioeconomic, infrastructure, and environmental. Each of these components is comprised of graphical overlays and associated descriptive records. For cadastral information, the graphical overlay is the cadastral index map, which is comprised of the individual cadastral plans.

Descriptive data which are associated with the cadastral index map include title records, valuation and assessment records, and the land registry data. Land related records in the land registry of Tanzania include land registration records, mortgages, liens and several other records which can be associated with a cadastral index map.

Since the topologically structured cadastral index map is not exact in metric space, the original cadastral survey field data and the cadastral plans are integral to the system. The survey field data and the accurate (in metric space) cadastral plans should be linked to the appropriate parcels in the cadastral index map so that an accurate cadastral map can be constructed from this data. Other information support components will also have the requisite graphical and textual data types which are relevant to the objectives of the model.

The infrastructure information component, for example, consists of the graphical data pertaining to road center lines, pavement, water, and electricity lines together with descriptive records such as road surface type, road maintenance schedule, etc.

Socioeconomic information would include human and natural resource maps and the associated demographic records. The environmental component would contain natural resource data and hazard maps together with records of environmental impact studies. It must be mentioned at this point that whereas some of these data types and records may exist in paper format, no attempts were made to develop the other information support systems. As such, no effort was made, either to extract or convert data to support those information systems in this research.

A spatially referenced land information model includes a spatial referencing framework, upon which the graphical layers within the individual information systems depend for positional accuracy and coincidence. Existing models of multipurpose land information systems employ a geodetic reference framework. A brief description of the procedure for compiling a cadastral index map within a geodetic reference framework is given below in order to highlight the major differences from a topologically structured model.

Cadastral Index Map Compilation in Metric Space

Compilation of cadastral index map in a geodetic reference framework requires a transformation of the individual cadastral maps and plans from their original referencing system into the geodetic reference framework. The Affine transformation function is generally adopted for performing such transformations, unless there is justification to use a different transformation. The Affine transformation function is of the form:

$$X' = Ax + By + C$$

$$Y' = Dx + Ey + F$$

To transform from one system into a Geodetic Reference Framework (GRF), the transformation function will be of the form:

$$X_{GRF} = Ax + By + C$$

$$Y_{GRF} = Dx + Ey + F$$

The unknown quantities in this function (A, B, C, D, E, and F) can be solved uniquely with three common non-collinear points in the two systems. Additional points provide a check and allow application of a least squares approach to the solution. The results provides equivalent coordinates in the GRF system for each point that was used, and some residual. From the residuals, a Root Mean Square error (RMS) of the transformation can be calculated. The RMS error is calculated from the function :

$$RMS_e = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 + \ldots + e_n^2}{n}}$$

where n is the number of points that were used in the transformation and e denotes the individual residuals . e is obtained by the equation $e = \sqrt{(v_x^2 + v_y^2)}$,

where v represents the individual residuals in x and y. The RMS error gives an indication of how good the transformation is. The lower the RMS error, the better the transformation.

In situations where there are several cadastral plans, each plan has to be transformed independently into the GRF system. The effect of these residuals, together

with other errors such as methodology and plotting accuracies can, and often do, result in gaps between parcels or overlapping parcels instead of contiguous parcels (see Figure 6-1).

In Figure 6-1, two separate plans of contiguous parcels have been drawn in different referencing systems. Both plans have controls in a geodetic reference framework. To reproduce the plans in the required geodetic framework, they both have to be

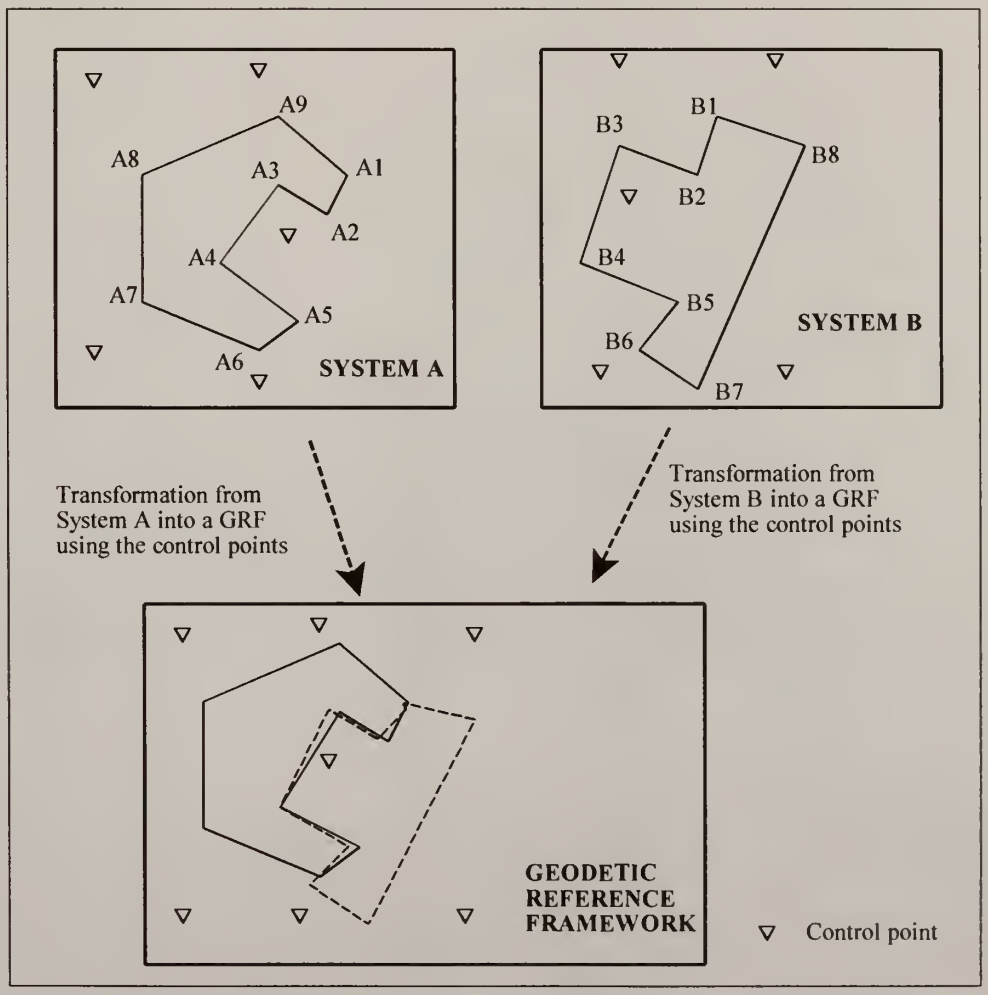


Figure 6-1: Coordinate Transformation in Metric Space

transformed. A hypothetical, yet common occurrence is shown below, whereby the two parcels are not matching exactly even though they are supposed to be contiguous. Different methods have been adopted to make the plans match exactly. Such methods include averaging out the discrepancies or "rubber-sheeting" one drawing to fit the other.

With reference to Tanzania, it has been mentioned earlier that whereas relative accuracies between neighboring survey projects are within acceptable tolerances (with regard to the stipulations in the Survey Regulations of Tanzania), excessive misclosures are observed with respect to absolute positions. This implies that a coordinate transformation would result in large RMS errors. In a measurement based (metric space) model, such discrepancies would require re-adjustment of the survey control network, followed by a re-compilation of the cadastral index map. Both of these activities are expensive propositions which cannot be met with the meager financial and human resources that are available in Tanzania. In addition to these mitigating factors, the production of an accurate cadastral maps for Tanzania would be a time consuming project.

Evidence from this research indicates that the standard sheets in Tanzania are outdated due to lack of maintenance. There is no reason to believe that even when a mechanism for updating the standard sheets is implemented, compliance can be enforced. The adoption of a topological approach is a way to curtail expenditure, provide a method for creating an index map which is consistent in detail to what exists on the ground, and robust to allow the performance of spatial analysis on the associated data.

Cadastral Index Mapping in Topological Space

In topology, the important criterion is the consistency of the data in topological space. This implies ensuring that spatial relationships between individual parcels are consistent with what exists on the ground. For a cadastral index map, a geodetic reference framework is not critical as adjacency relationships are more important than absolute positioning. In order to merge the individual cadastral plans common points are required for transformation. However, as shown in Figure 6-2, the individual plans are transformed, not with control points on the plans, but with common points on adjacent external boundaries of the plans.

In the Figure 6-2, the cadastral maps A, B, and C are contiguous cadastral plans that need to be assembled together topologically. Cadastral map A is chosen as the base layer, onto which the other plans are going to be linked. The identical points A1 to A6 on map A, and B1 to B6 on map B, are used as the control points for the transformation. With six control points to be used in an Affine transformation, a least squares solution will yield some residuals.

Point equivalency is established between the two maps by connecting points B1 through B6 to the corresponding points A1 through A6. This forces the corresponding points to snap together. The position of the remaining points is a result of application of the transformation coefficients. The resultant map is shown in D.

In a similar fashion, the cadastral plan, C, is connected to the composite map, D, with the common points A8, A9, A1, and B8 connecting to C1, C2, C3, and C4. The final cadastral index map is shown in E.

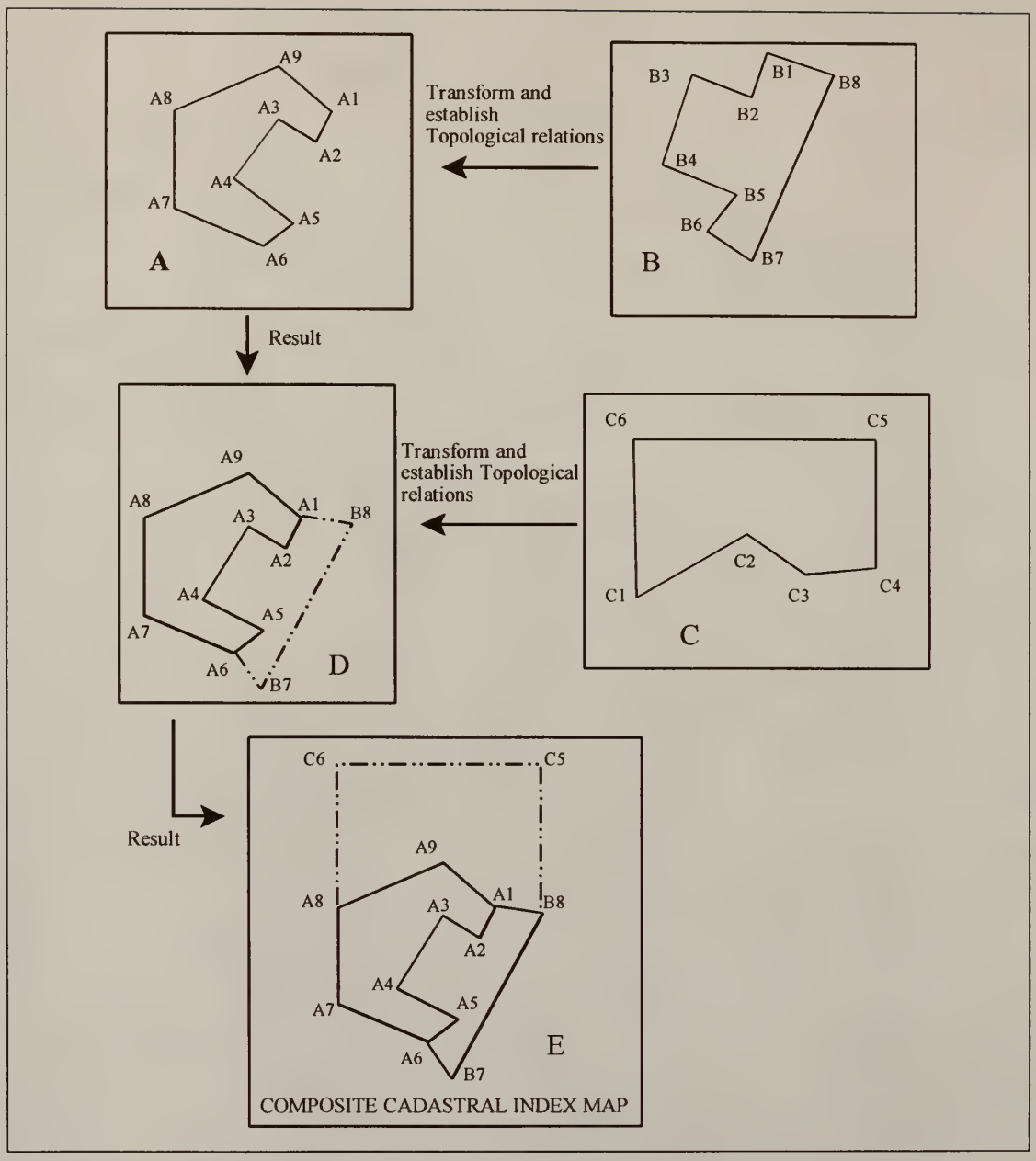


Figure 6-2: Topologically assembled cadastral index map

As expected, the resultant map has all the points connected. There are no gaps or overlaps. As such, there are no more adjustments to be made on the final figure, as was the case with the cadastral index map in metric space. This approach for producing the

cadastral index map has been adopted in this research. In the next section, an application of this procedure for developing a cadastral information system for Tanzania is presented.

Cadastral Information System for Tanzania

In Figure 5-6, a model for developing a topologically structured multipurpose land information system was presented. The highlighted portion of Figure 5-6 shows the cadastral information systems component of the model. The distinct feature about this model is the fact that the cadastral information systems component is independent of the geodetic reference framework.

Beside hardware, software, and human resources, the components of cadastral information system include the cadastral index map, a parcel identification structure through which parcels can be uniquely and easily be identified, and the descriptive records. In Chapter 5, a procedure for isolating erroneous and inconsistent records in Tanzania was developed. In this section, a procedure for developing the topologically structured cadastral index map and the development of parcel identification system are presented. These approaches are then applied in a pilot project to assess their effectiveness.

Cadastral Index Map for Tanzania

By applying the topologically structured cadastral index mapping concept for the Tanzanian land information model, the available graphical data need to be converted into a digital format in order to apply the topological principle. The different types of graphical

data in Tanzania include subdivision plans in local coordinate systems, subdivision plans in a national geodetic coordinate system, and survey field notes.

Figure 6-3 shows a schematic diagram for converting the different types of graphical data that were available in the Surveys and Mapping division in Tanzania. The cadastral index map for the pilot study in Tanzania was created from the following graphical data sources:

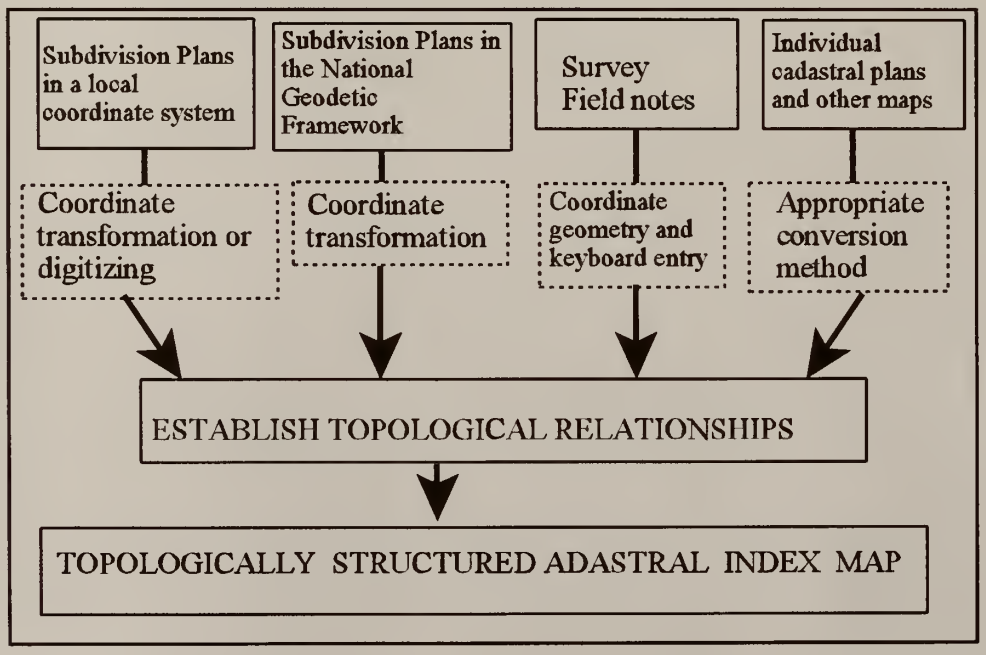


Figure 6-3: Graphical data conversion options

1. An existing standard sheet at a scale of 1:2500 which was created in 1980 by photogrammetric methods. The map was in paper format and contained coordinates in the Universal Transverse Mercator projection.

2. Existing subdivision maps at a scale of 1:2500. As a regulation in Tanzania, all subdivision surveys have to be tied to the national geodetic coordinates system, unless prior permission has been given by the Director of Surveys.
3. Computed coordinates of field survey data.

Although it was not by design, the data for the pilot study did not include graphical data in a local coordinates system. Even though certain parts of Tanzania have been surveyed on local coordinate systems. Among the graphical data sets that were available, the standard sheet contained the most property boundary points. This meant that contiguity had already been established among those parcels that were on the base map. All the other pieces of graphical data were inserted into the standard sheet. Figure 6-4 shows a schematic diagram of the process for converting the different data types into a digital format and maintaining spatial relationships.

The base layer. Since the standard sheet contained the most data in terms of property boundaries, the process began with the existing but outdated 1:2500 scale standard sheet. It was assessed for quality in terms of line work, creases and smears, and determined that the base map was in good enough condition to be digitized. The grid intersections on the 1:2500 scale standard sheet were used as control points to register the map with the digitizer through an Affine transformation. The parcel corners were digitized according to the rules which were established in Chapter 5.

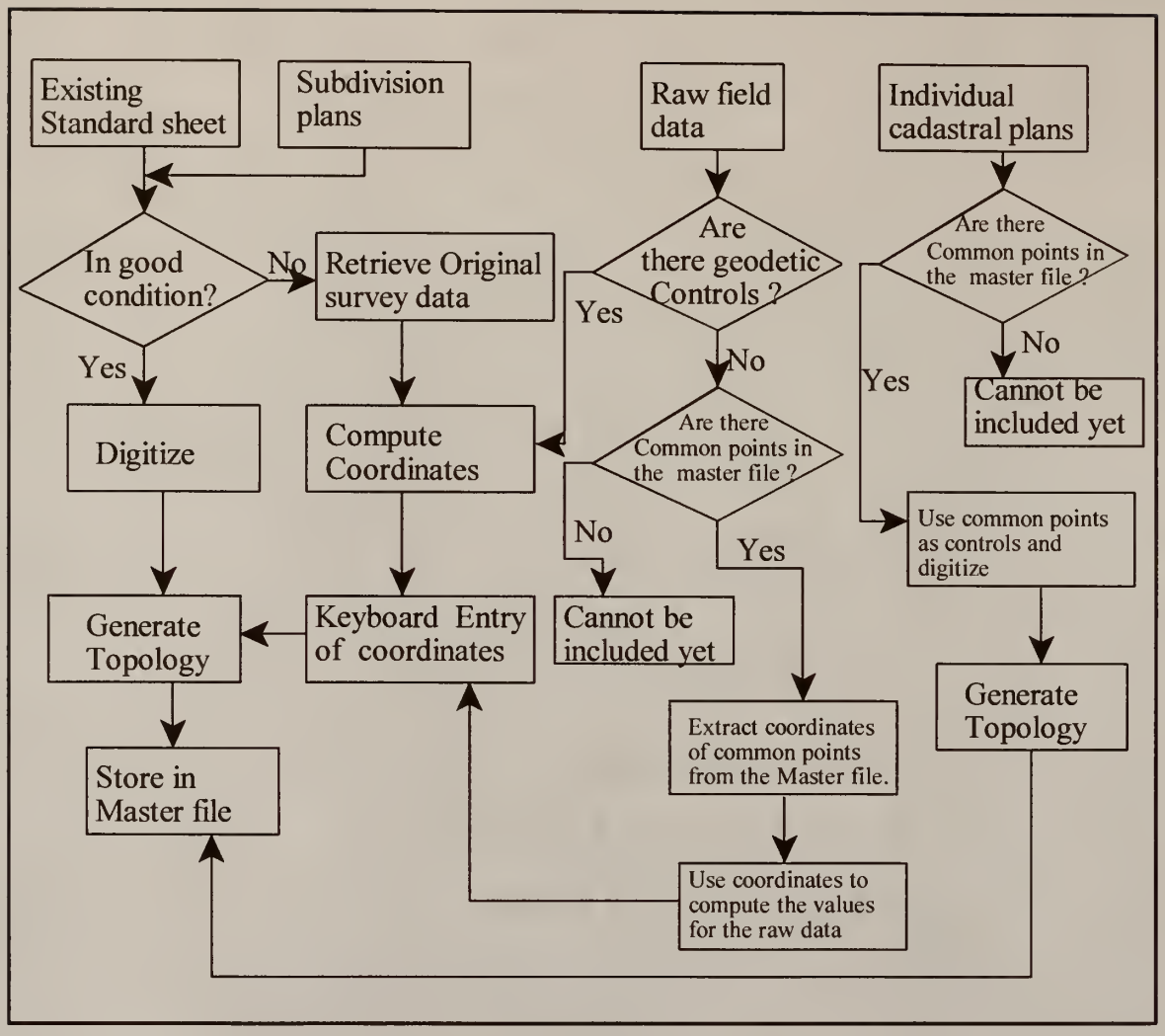


Figure 6-4: Creating a Cadastral Index Map for Tanzania

Due to the imprecision of the digitizer and the rounding-off errors of the computer (when working in single precision), a threshold of 1 meter was set so that nodes that fell within 1 meter of each other were considered identical, and therefore snapped together. By the node snapping rule, the new node snapped to the old one. The digital cadastral map was then checked to ensure that the boundary lines closed to form polygons. The software that was used (ArcInfo) contained a commands for isolating and correcting non-closing polygons as well as overshoots at the nodes. Topological relationships between the nodes, boundary

lines and the individual polygons were established with the appropriate commands in the software. The finished digital cadastral map became the master index map.

Although the standard sheet contained some geodetic control points, the traverse boundaries of the original subdivision plans, from which the standard sheets were prepared, were not drafted. In order to merge the subsequent subdivision and cadastral plans to the digitized standard sheet, the traverse boundaries of subdivision plans, which produced the standard sheet, were drawn and digitized. The traverse points provided the needed common points between adjacent subdivision plans. This process was described in Chapter 5.

Subdivision plans. The subdivision plans which had not been used to update the hard copy standard sheet had all been drawn on mylar at a scale of 1:2500. Suitable and well maintained subdivision plans were digitized into the master index map. Although the subdivision plans were drafted in the Tanzania geodetic referencing framework, the coordinates were irrelevant at this stage.

Registration of the subdivision plans to the master index map was accomplished by selecting at least three common points between the master index map and the subdivision plan, and performing the transformation. The reason for using common points between the two maps method was to avoid having to deal with too many overlapping parcels and boundary lines that crossed one another. In order to achieve this, it was necessary to find at least three points that were common between the two maps. The use of topology ensured that the residuals that remained as a result of the least squares transformation did not affect the final outcome of the map. This was accomplished through the node equivalence and line

equivalence relationships that were discussed in Chapter 5. A snapping distance of 1 meter was set for the subdivision plans too.

Because there was contiguity among the parcels within any subdivision, minimal effort was needed to ensure that the spatial relationships were being maintained. However, attention had to be focused on the individual parcels within the subdivisions. It was necessary to guard against the influence of neighboring nodes and lines on vertices. Overshoots were introduced wherever necessary to ensure that the external lines did not snap to node unduly.

Although the situation did not occur during the pilot study, the intention was follow the procedure shown in the Figure 5-10, to compute coordinates for subdivisions that were too creased to be digitized and then transform the computed coordinates into the master index map. In situations where the common points had different coordinates, due to errors in the survey controls, the procedure would have been to transform the subdivision coordinates into the master index coordinates before doing the data entry with by the keyboard.

Raw field data. Raw survey field data were treated in the same manner as subdivision plans that were unsuitable for digitizing. Raw field data that was based on local coordinate system were processed (through coordinate geometry) with controls that had been extracted from the master index map. In situations where there were no common points between the two maps, it was impossible to incorporate the data into the master

index map. It had to wait until the data become available for doing the required computations.

Individual cadastral plans. The easiest approach to incorporate individual cadastral plans that were plotted in a local coordinate system into the master index map was to identify common points in the master index map and to use those to digitize and to generate topology.

Topologically structured overlay using a combination of existing cadastral maps was the most appropriate option since that did not involve large-scale production of a cadastral maps (which would be accurate in metric space), either by aerial photogrammetric methods or traditional surveying methods. A topologically structured cadastral index map has a great deal of potential in this regard. The effects of measurement errors and inconsistencies due to instrument type and methodology are secondary as a result of establishing spatial relationships in the topological structure.

Linkage Mechanism

Actual cadastral plan and field survey data may be associated with the parcel through a linkage mechanism. In a parcel based system, the linkage mechanism may be the same as the parcel identifier. The developmental approach for a choice of linkage mechanism for cadastral data in Tanzania is discussed later in this chapter.

Through linkage mechanisms, the individual information support systems are related to each other. Descriptive information which may be also be associated with the cadastral index map are the legal property description of the parcel, valuation and assessment data, mortgage information, and other pieces of data that are registered in the land registry. Similarly, graphical data that may be associated with infrastructure information systems are road center lines, pavements, and utility lines.

Although each division and each section within the Ministry of Housing and Urban Development has a numbering procedure for its paper files, there is no mechanism for linking files from one section to another. For example, in the Land Development Division, all files pertaining to land allocations are given land office numbers, which are issued by the statistics office. A range of numbers is issued to each zone as they are needed. There is no way of isolating files from any particular zone or region without first knowing the range of numbers that have been assigned to that region over the years. After the range of numbers has been allocated to the region, the numbers are issued to transactions in the order that the transactions are recorded.

The zonal officers do not incorporate intelligence into the numbering procedure. Similarly, file numbers are issued at the land registry. The numbers are sequential and are issued to the transactions in the order that they are received. Because the files that are created at the land office are separate from those at the land registry, some types of information are duplicated.

Parcel identifiers. In defining a system for identifying parcels, the criteria were to develop a numbering system which was simple, easy to understand, unique, and manageable within the computerized environment. A general method for people in the urban areas of Tanzania to locate or describe their residence or property is the use of location name, block number, and parcel number. For example, Sinza, block 46, plot 124, is a valid and easily understandable location description in Dar es Salaam.

A recommended approach for assigning parcel identifiers is to use a hierarchical approach involving the administrative region, district, location, block number, and plot number. There are 20 administrative regions and 104 districts in Tanzania. The coding structure for a parcel identifier was for a region to have a 3 digit code beginning at 100, whiles districts would have a 3 digit code starting at 001.

There are no districts with more than 99 townships or cities, therefore locations will be assigned 2 digit codes. Block numbers will have 3 digit codes, implying that there could be a maximum of 999 blocks within a location. Within each block, plot numbers are assigned a 3 digit codes starting from 001. This means there could be a maximum of 999 parcels within a block. The approach for assigning hierarchical numeric codes to parcel identifiers is shown in Tables 6-1 and 6-2.

There are 3 districts in Dar es Salaam; Ilala, Kinondoni, and Temeke. The codes for these districts are 001, 002, and 003, respectively. To identify Kinondoni in Dar es Salaam, the code will be 102002. By assigning the area called Kijitonyama a code of 06, a parcel number 35, inside Block 44, in the Kijitonyama area, in the district of Kinondoni will have an identifier of 1020020604403500. The last two digits are reserved for any further

subdivision, especially in the case of agricultural property. In the case of amalgamations, an entirely new identifier is assigned. A remark is made in the register to indicate that the new number replaces the two previous numbers as a result of an amalgamation.

Table 6-1: Coding structure of Parcel Identifiers

Item	Numeric Code (digits)
Region	3
District	3
Location	2
Block	3
Plot	3
Further subdivision	2

The parcel identifiers will be assigned by the survey division after the survey has been approved by the Director of surveys. Since the approved survey plan is the one that is used for land allocation, this means that all parcels will have identifiers before they are allocated. This does not prevent other sections or divisions within the Ministry from assigning their own numbering system.

Table 6-2: Codes for Administrative Regions in Tanzania

REGION	CODE
Arusha	100
Coast	101
Dar es Salaam	102
Dodoma	103
Iringa	104
Kagera	105
Kigoma	106
Lindi	107
Mara	108
Mbeya	109
Morogoro	110
Moshi	111
Mtwara	112
Mwanza	113
Rukwa	114
Ruvuma	115
Shinyanga	116
Singida	117
Tabora	118
Tanga	119

In this chapter the problems and concerns that were identified during the study of the Tanzanian land delivery system have been addressed. A cadastral information model

has also been developed for Tanzania. A topologically structured approach for developing a cadastral index map has been presented. A unique parcel identification system for Tanzania has been presented as part of the solution to the information management problems. These approaches and solutions are tested during the implementation of a pilot project in chapter 7.

CHAPTER 7
PILOT PROJECT

This chapter begins by incorporating the solutions, recommendations and approaches developed to address the problems and concerns that were identified during the study of the land delivery arrangements in Tanzania. The solutions developed include a topologically structured approach for developing a cadastral index map from varied sources of cadastral plans and subdivision maps that are available at the Surveying and Mapping division.

Approaches were developed for removing inconsistencies and erroneous data from the descriptive records at the land registry as well as the land office. The "error free" records were linked to the cadastral index map and some spatial analysis was made on the data.

The objectives of the pilot project were to assess the viability of the topologically structured cadastral index mapping approach and the subsequent ability to perform spatial analysis, and the records reorganization and modernization approaches that have been put forward.

For this purpose, a 15 square kilometer area in Dar es Salaam was chosen for the pilot project. The area contained 11 subdivision blocks and approximately 5000 parcels (see Figure 7-1). Figure 7-1 shows an area containing the site for the pilot study. The site was chosen because that part of Dar es Salaam was developed in 1986 so the area was

Figure 7-1: Vector Drawing showing Pilot Area

believed to have relatively complete and up-to-date records. The implies that the results obtained from the pilot project would reflect the "best-case" scenario.

Data Sources

Data for the pilot project consisted of the relevant graphical data and textual information for the pilot area. The original data were compiled from multiple sources comprising of:

1. direct keyboard entry of mathematically computed survey coordinates, a digitization of hard copy cadastral plans. Some of the coordinates were based on the National Geodetic Coordinate system of Tanzania while other map coordinates were on local systems;
2. direct plotting from original survey field books;
3. digitization of hard copy cadastral plans, some of which were without coordinates, others were on a local coordinates system, while the remainder were on the national geodetic coordinate system.

The pieces of graphical data were "stitched" together using topological relationships between identical parcel corner monuments and common boundaries between adjacent parcels. The composite vector map was incomplete as a result of missing records and maps that were too creased to be digitized. A geo-referenced aerial photograph was used as a backdrop to update the vector data. The aerial photographs were taken in 1992, using a metric aerial camera with a focal length of 152 mm. The flying height of the aircraft above mean terrain was 1900 m., yielding an average photo scale of 1:12500.

The descriptive records for the parcels were all obtained from the files of the Surveys and Mapping division. The records contained minimal information regarding the location, block name, and plot numbers for each parcel. A combination of the location, block name, and the plot number identified each parcel uniquely. Table 7-1 shows the attribute data that were obtained from the Surveys and Mapping division.

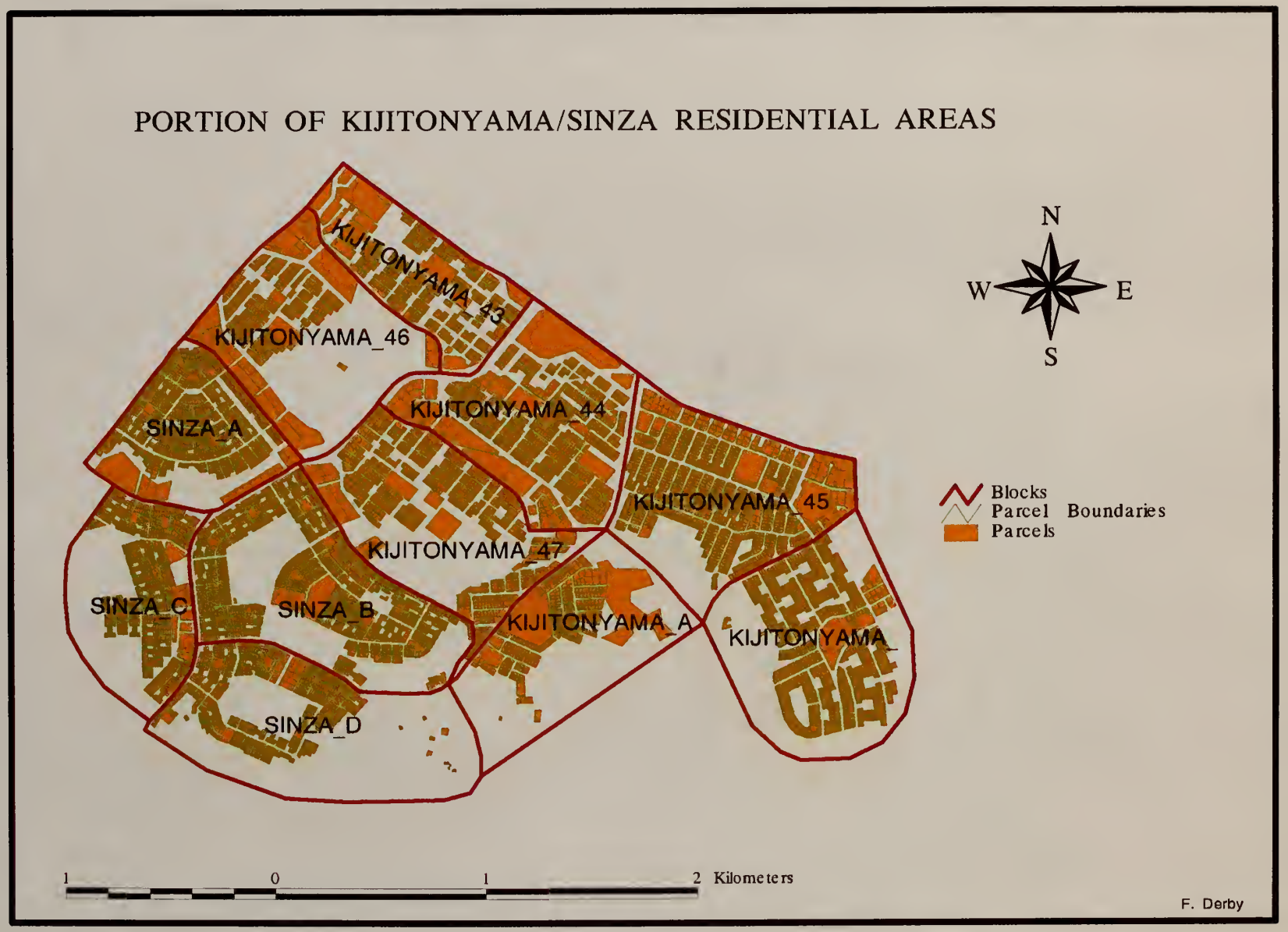
Table 7-1: Textual information associated with Individual Subdivision/Cadastral Plans

Location
District
City
Block name
Parcel number
Calculated Area

After the cadastral index map had been converted into the appropriate format, topology generated, and with all the errors removed, attribute information was added from the records at the Land Development division. Figure 7-2 shows a plot of the selected pilot project area after the spatial data had been converted into a software readable format. The type of attribute information which was associated with the cadastral map is shown in Table 7-1. A look-up table was created to associate the data with the new parcel identifiers. The numbers were assigned on the basis of the information contained in the register.

Relevant textual information regarding ownership, address, and rent assessment value, were obtained from the land office and the land registry in the Land Development division. The reason for using two sources of data was to reduce the chances of errors by

Figure 7-2: Topologically Generated Cadastral Index Map of Pilot Area


PORTION OF KIJITONYAMA/SINZA RESIDENTIAL AREAS
KIJITONYAMA_43
KIJITONYAMA_46
KIJITONYAMA_44
SINZA_A
KIJITONYAMA_45
KIJITONYAMA_47
SINZA_C
SINZA_B
KIJITONYAMA_A
KIJITONYAMA_
SINZA_D
N
W
E
S
Blocks
Parcel Boundaries
Parcels
1 0 1 2 Kilometers
F. Derby

isolating as many errors and inconsistencies as possible. Since each parcel has to be allocated before it can be registered, it was logical to presume that the land office records will have more data pertaining to land allocation whiles the land registry will have only the records pertaining registered titles. The records showed that more parcels had been allocated than those that had actually been registered.

The data from the land office were extracted from the paper files which were maintained at the office while the land registry data were extracted from the land register. All the textual data from both offices were entered manually into the computer.

Hardware and Software

As part of this research, computer hardware requirements were determined during the needs assessment phase. The choice of hardware configuration was based on the objectives of the project, compatibility with the software, ease of maintenance, and cost. Local knowledge in computer technology eliminated the use of UNIX based workstations as well as any technology that required networking capabilities. Furthermore, existing infrastructure in Dar es Salaam, with regard to smooth (spike-free) electrical current, reliable telephone lines, and fire protected buildings imposed restrictions on the hardware choices that were made at the time of the pilot study.

In 1995, the best configuration was a desktop Personal Computer which was equipped with an Intel DX4™ chip that ran at 100 MHz. The available operating system was Windows 3.1™ by Microsoft Corporation. Other hardware options included 32 MB of Random Access Memory (RAM), and 1 Gigabyte of hard drive storage space.

The software of choice included PC version ArcInfo™ and ArcView™ from Environmental Systems Research Institute (ESRI), Autocad™ from Autodesk Incorporated, and DbaseV™ for Windows from Borland Corporation.

Analogue Image Conversion.

Single aerial photographs normally have planimetric distortions such as those due to the camera attitude at the time of exposure, distortions due to manufacture, and image displacements due to ground relief. As the mapping process was based on spatial relationships, spatial accuracy in the graphical overlay did not pose a problem since the focus was on relative positions of the parcels. In order to obtain a digital image with a ground resolution of 0.3 m., a micro-densitometer was used.

For a camera focal length of 0.152 m., average flying height of 1900 m., the ground coverage on a .23 m. (9 inch paper) is

$$\frac{1900 \times 0.23}{0.152} = 2900 \text{ m.}$$

On a .23 m. (9 inch) format, the ground resolution of .3 m. would require the micro-densitometer to be set at

$$\frac{0.3 \times 0.23}{2900} = 24 \ \mu m.$$

For a single photograph, the resultant digital image is approximately 83.7 MB. in size. The image was saved in a Tagged Image File Format (TIFF).

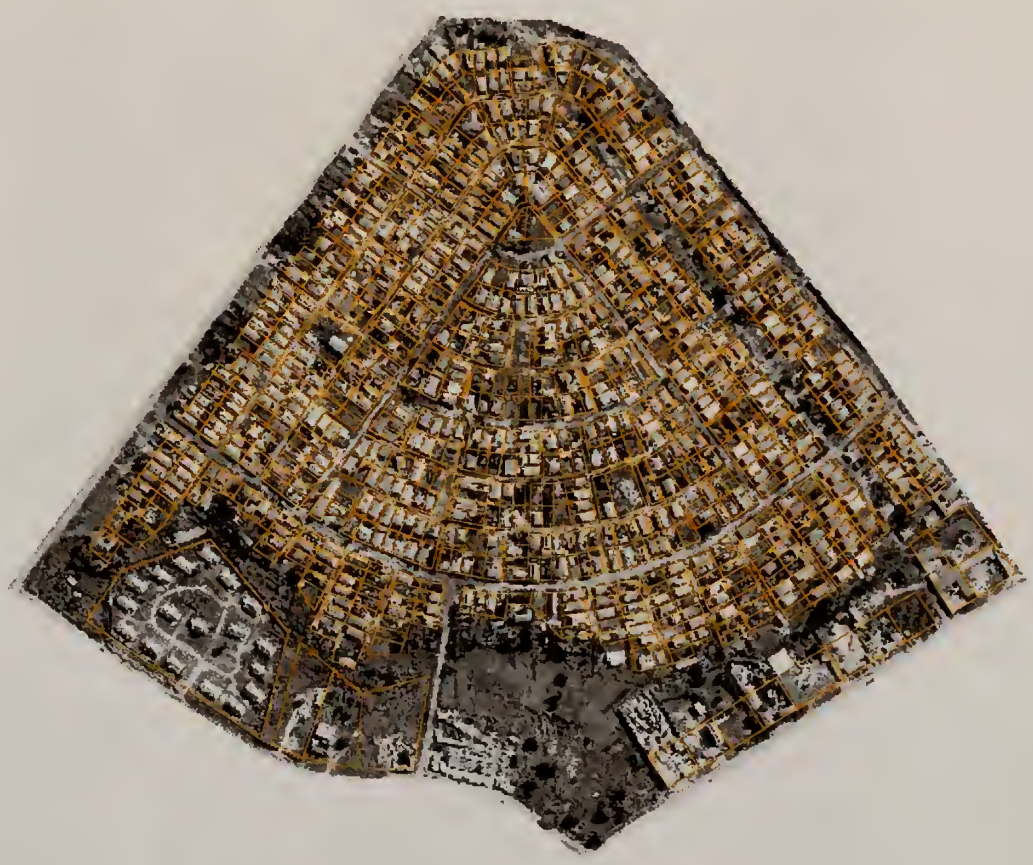
To geo-reference the image, control points which could be identified on both the image and the cadastral index map were selected. Corresponding pixels were assigned the coordinates that were obtained from the cadastral index map. An Affine transformation was performed after the location of the points had been identified in the image, to geo-reference the image to the coordinates system of the cadastral index map. Although a Projective transformation would have been more accurate, the software that was used in this research did not have Projective transformation capabilities.

Pixel values were obtained through a neighbor resampling method. As a result of the simplicity of the nearest neighbor resampling method, the possibility of pixels being displaced by up to one-half pixel was considered to be insignificant for the purpose of this research.

A subset of the image was selected for the pilot project. An overlay of the property boundary map and the geo-referenced image was made. This exercise demonstrated the possibility of utilizing existing aerial photographs to update obsolete vector maps (see Figure 7-3). As can be evidenced at the south-west corner of Figure 7-3, there are structures on individual properties but the property boundaries have not been shown on the vector layer. The image may therefore be used to update the cadastral index map if evidence of a boundary such as a fence line or a hedge can identified on the image. On the other hand surveyors could visit the location and update that portion of the map without having to do an expensive and accurate survey.

Figure 7-3: Topologically structured cadastral index map on a geo-referenced image

Cadastral Map on Aerial Photograph



300 0 300 Meters

N
W E
S

Property Boundary

Attribute Data Processing

The textual data which were extracted for the 5000 parcels were entered into the computer using DbaseV™ for Windows. Erroneous data such as a parcel allocated to more than one person or records that had erroneously been entered more than once. Because the land office and the land registry had independent numbers for each record (see Table 7-2), it was necessary to ensure that those internal numbers had not been duplicated. However, difficulty arose if the same parcel had been assigned two different internal numbers. This could happen if the same parcel was allocated to two or more people at different times. In a manual processing system, such mistakes can occur. During the manual data entry process, problems ranging from duplicate allocations to missing files were identified.

Table 7-2: Relevant Textual Information from Title Office and Land Registry

Land Office Data	Land Registry Data
Location	Location
District	District
City	City
Block name	Block name
Parcel number	Parcel number
Calculated Area	Calculated Area
Land Office number	Land Office Number
Rent	Title Number
Lease Term	Lease Term
Start Date	Start Date
Ending Date	Ending Date
Owner's Name	Owner's Name
Owner's Address	Owner's Address
Property Description	Date of Registration
	Time of Registration
	Property Description

An internal consistency check was conducted within the database to ensure that city name, block name, and parcel number were unique for all parcels. Parcels which were found to violate such conditions were isolated for verification. The procedures for checking and isolating errors followed simple rules which were described with the diagram in Figure 5-3. Although the procedure isolated several of the parcels with inconsistent records, there was no record of the number of parcels that are already pending adjudication before the courts. Some of the missing files could be in the custody of the courts, pending resolution of legal ownership.

Parcel identification. In order to establish a unique identifier for parcels within the pilot area, utilizing the relational database concept, it was necessary to establish primary keys which uniquely identified each parcel. Table 7-2 indicates several items have been recorded twice between the two databases. Although the land office provided a unique identifier, it was also duplicated in the records at the land registry. The primary search key for the land office records, therefore, was a combination of location, district, city, block name, parcel number, and the land office number. This combination established a tuple which could be used to access the records within the land office records. To access records from the land registry database, a secondary key, which was the title number was used. The property description was long and verbose which made it unsuitable for parcel identifier. The newly created identifier had not been assigned to the descriptive data at this stage.

The procedure for isolating inconsistencies were done by using the following simple rules:

1. Perform internal checks on the database to ensure that no two records had the same location name, subdivision name, block name or parcel identifier.

Sample pseudo code for checking record consistency is as follows:

```
Begin
    name = city + block name + parcel number ;
        i = 1;
        while (not end of list){
                j = i ;
                while (not end of list) {
                                increment j;
                                if (name(i) = name (j)) then
                                print "record number (i) is the same as record number (j)";
                 }
                        increment I;
          }
end.
```

Inconsistent records were isolated for checking. If such records had the same owner's name and address, then it was just a recording error and one of the records was discarded. Those with different owners were forwarded for verification. The checking was done for the graphical data as well as the two textual databases. Table 7-3 shows a break down of the problematic files which were identified for two of the test areas during the manual data entry process.

Table 7-3: Erroneous Records Identified during data entry at the Land Office

	Kijitonyama Block 44	Sinza Block A
No. of Parcels	694	820
Missing Files	51	66
Files with inconsistent data	42	59
Total	93	125
Percentage	13.4	15.2

2. The land registry database was associated with the cadastral map and checked for consistency. Parcels which could not be associated with the appropriate records had not been registered although they may have been allocated to applicants and titles had been issued. Table 7-4 shows the number of records that were isolated during this checking process.

Table 7-4: Erroneous Records Isolated during data entry at the Land Registry

	Kijitonyama Block 44	Sinza Block A
No. of Parcels	601	695
Missing or Unregistered records	148	177
Files with inconsistent data	-	-
Total	148	177
Percentage	24.6	25.5

3. After associating the land office records with the cadastral maps, parcels that could not be associated with records had either not been allocated to anyone or that the

file for that particular parcel was missing (or misplaced). In this case, the only way to rectify this problem would be a site visit to obtain the original documents from the owner. Table 7-5 shows the results of the internal checking among the records at the land office.

Table 7-5: Results of Internal Consistency Check among the Land Office records

	Kijitonyama Block 44	Sinza block A
No. of Files	601	695
Parcels with Different owners	23	17
Parcels with identical numbers	15	6
Total	38	23
Percentage	6	3.3

4. The two databases from the land office and the land registry were related to each other with parcel identifiers. A check on the resultant information was performed to ensure that for each parcel, the name of the owner in the title office and that in the land registry are the same. Any discrepancies were again isolated for verification. Reasons were that a land transfer occurred for which the land office information was changed but the title has not yet been registered. Another possible reason could be the unlikely situation that a fraudulent transaction had taken place. Table 7-6 shows the results of this checking process.

Table 7-6: Inconsistencies among Land Office and Land Registry records

	Kijitonyama Block 44	Sinza Block A
No. of Parcels	563	672
Inconsistent L. O. and L. R. names	17	29
No. of Error-free Records	546	643
Percentage	3	4
Overall Percentage of good records	78.7	78.41

5. Any of the remaining parcels that remained after all these checks could be considered to have been appropriately, allocated, titled and registered.

Although the final result may be considered wholesome, the records still need to be verified because of possible unofficial transfers which have not been recorded anywhere. Furthermore, owners may have changed mailing addresses. In Tanzania, in the 1980s, several people used the office of the affiliated political party as their mailing address. Those political parties are now defunct but the records have not been rectified. It is therefore recommended that systematic record verification and address correction be done on the final list.

Spatial Analysis

Having combined the spatial data with the attribute information, ad hoc queries were performed on the resultant descriptive data to derive spatially referenced responses

to the queries. Various types of spatial queries were performed on the data. Table 7-7 shows the types of queries that could be performed on the spatial data and the associated descriptive information with explanations on the objective of the query. Some of the queries that were made on the data include:

1. Logically querying the records to find the number of unregistered parcels in selected locations within the pilot project area. This is important for the land managers to identify missing data within the land registry database. For effective land management, the cadastral information must be complete.

Table 7-7: Query Types That Were Done on the Cadastral Information

SPATIAL ANALYSIS GROUP	QUERY TYPE
Proximity analysis	When information are needed about areas surrounding existing features.
Boundary operations	When the information that are needed can be selected by their geographic locations.
Logical operations	When the information that are required can be selected by their descriptive attributes only.

Missing information also implies that the government has no way of collecting property taxes from the owners of those properties. Although this observation was not part of the original objective, the secondary benefit of this formation system is particularly important for economy of the country.

2. Finding the variation in the land rent that owners of parcels within any particular block in the pilot project area are supposed to pay (see Figures 7-4 and 7-5).

Figure 7-4: Land Rent analysis on Kijitonyama Block 44

KIJITONYAMA BLOCK 44

SHOWING RENT DISTRIBUTION BY PARCELS

IN SHILLINGS

LEGEND

PARCELS

	(148)	UNREGISTERED PLOTS
	(23)	0 - 100 Shillings
	(418)	100 - 500 Shillings
	(16)	500 - 1000 Shillings
	(89)	1000 - 15000 Shilllings

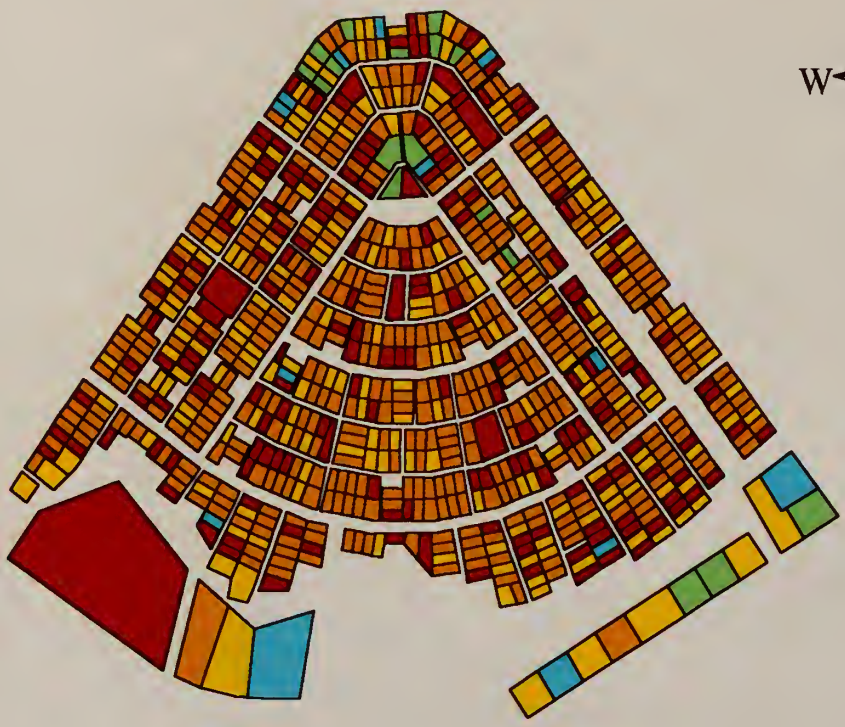
F. Derby

Figure 7-5: Land Rent Analysis on Sinza Block A

SINZA BLOCK A

RENT DISTRIBUTION BY PLOTS

IN SHILLINGS



LEGEND

PARCELS

(177) UNREGISTERED PARCEL
(423) 0 - 100 SHILLINGS
(190) 100 - 500 SHILLINGS
(17) 500 - 1000 SHILLINGS
(13) 1000 - 42000 SHILLINGS

Total : 820 Plots

The result of this query identifies the weaknesses in the land assessment procedures, especially when it was observed that wide discrepancies exist between identical parcels within the same block. The information from the database indicate the amount of revenue that the government should realize if an efficient revenue collection system is implemented. It also indicates that the amount of tax per parcel is too little for the government to be able to provide adequate infrastructure without supplementary with finance from other sources. The results of a query of this nature, based on logical operation on the database, provides a justification for a land tax review.

Summary and Analysis of Results

In this section the results of the pilot project were reviewed with respect to the objectives and the focus of the research. The results were then analyzed with respect to the applicability to the Tanzania problems, the ability of the long term impact on Tanzania. Recommendations were then presented to ensure continuity and sustainability of the project in Tanzania. This analysis deals with the problems that were identified during the study of the land delivery processes in Tanzania and the solutions that were presented in the preceding chapters. The next chapter dealt with the conclusions and recommendations for further research with regard to the topologically structured cadastral model and other contributions to field of cadastral information management.

The pilot project was developed to test the solutions and recommendations that were presented in Chapter 5 to address the problems and concerns regarding the Tanzania land delivery process. This pilot project demonstrated the following:

- an approach for creating a topologically structured cadastral index map to support land related information systems. The concept incorporates cadastral plans and maps from diverse sources with different spatial accuracy of the features. In establishing topological relationships, rules and procedures have been developed for achieving the best results.
- a systematic procedure for isolating the errors in the parcel allocation process and the preparation of Certificates of Occupancy at the land office.
- a procedure for isolating erroneous and inconsistent records from the land registry records in Tanzania.
- an approach for maintaining consistency between the records of approved Certificates of Occupancy and the records to registered titles among the Tanzanian land records.
- The use of geo-referenced aerial photograph as a backdrop for digitizing and updating the cadastral index map.
- a flow-line for isolating discrepancies between the cadastral index map, land office records, and the land registry records.
- a unique parcel identification coding system for Tanzania land records.
- a procedure for streamlining data processing within the land management agencies in Tanzania.
- templates to be used at the document reception counters to facilitate document processing within the Ministry of Lands, Housing and Urban Development.
- computers at strategic locations within MLHUD which will be used to monitor

status of documents and to provide the necessary data for the land information system.

Although partial results were presented earlier in this chapter for two of the eleven blocks, the final results for the initial 5013 parcels are presented here for discussion. During the manual data entry process both at the land office and the land registry, some erroneous records were identified and rejected. Table 7-8 shows the number that were identified at both offices.

This is an indication that just the simple act of entering the records in the computer offered an opportunity to isolate 14.2% of the records at the land office. At first glance, it may seem that the 31% of the records at the land registry were either unaccounted for, but the number indicates titles that have not been registered. Some of these may be titles waiting to be registered.

Table 7-8: Internal Inconsistencies Identified During Manual Data Entry

	Land Office	Land Registry
Number of parcels	5013	5013
Missing records	455	1554
Files with inconsistent data	258	0
Total rejected	713	1554
Percentage	14.2	31

After the data had been entered into the computer, internal checks which were made to isolate duplicate records showed records which contained either duplicate land office numbers or parcels with duplicate owners. A total of 222 records were rejected. Table 7-9 shows results of the internal consistency check on the data for the pilot study.

Table 7-9: Results of Electronic Inconsistency Consistency Check on the Data

	Land Office	Land Registry
Number of Records	4300	3459
Inconsistent Owners	137	0
Duplicate Numbers	85	0
Total	222	0
Percentage	5.2	0

These results indicate the diligence of the staff at the land registry. But the fact that no errors were isolated at the land registry does not indicate that the names of the owners are consistent with the records at the land office. The next check would identify inconsistencies in the records between two offices.

The final check was to compare the records from the land office with the records at the land registry. Table 7-10 shows the results of the comparison.

Table 7-10: Comparison of land Office and Land Registry Records

	Land Office	Land Registry
Number of Records	4078	3459
Missing records	619	-
Inconsistent Owners	58	58
Total	677	58
Percentage	16.6	1.7

The comparison shows the possibility that there are 619 Certificates of Occupancy that seemingly have accurate information and are possibly waiting to be registered at the land registry. Altogether 3401 records out of the initial 5013 records passed the accuracy test. This constitutes approximately 68% of the data. This implies that even for the best case scenario only about 68% of the records may be considered error-free. The next action will be to check the validity of the owner's mailing address and other pertinent information within the databases. This could be done through systematic verification of the records. As far as purging the records of possible inconsistencies, the results indicate that the records at the land registry are reasonably reliable except for the current particulars of the owners.

The results of the rent analysis show the effectiveness of the parcel identification system and the topological structure which was adopted to create the cadastral overlay. The rent analysis is one of many analyses to which the records can be subjected. This simple test shows large disparity between land rents for identical parcels in the same

location. The results of the test suggest that a land rent review should be conducted so that fair and equitable land rent will be paid by all.

Although some of the problems and concerns mentioned in this research are specific to Tanzania, the topologically structured cadastral index mapping approach is a solution that can be beneficial to many countries that are contemplating the production of a cadastral index map. In this pilot study, the topologically structured cadastral index mapping approach has been successfully tested.

Until now, the approach for producing base maps for cadastral and land information management purposes has been in favor of accurate base maps, which necessitated comprehensive aerial photography, followed by stereo compilation and map production. Very often the map production was done at two or more scales (see Sonnenberg 1994; NRC 1983), one scale for urban areas and another for rural and agricultural areas. Not only is the topological approach economical (no extensive field surveys involved), it is also a time saver.

The results of the pilot project shows that the solutions and recommendations that were presented are feasible. The method for producing a cadastral index map has great potential application in developing countries. It was produced with no field survey work. It therefore has some economic advantage over full scale base map production.

The procedure for reorganizing existing records isolated a substantial amount of the inconsistent records. Although a large portion of those records were identified during the data entry process, the systematic approach presented here ensures consistent records

and promotes the integrity of the records at the Surveying and Mapping division, the Land Office and the Land Registry.

CHAPTER 8
CONCLUSIONS AND RECOMMENDATIONS

In Tanzania, availability of land is being gradually reduced by natural disasters such as coastal erosion, and increased pressure from population increase. The need to closely manage the land and its resources is becoming greater with time. In this research, it was shown that for some land management activities, accurate cadastral maps are not essential. It has also been shown that, whereas computerization of land records is essential for informed land management decisions, mere computerization does not resolve inherent problems of inconsistencies, incomplete and non-current data caused by maintaining records on paper.

Procedures to remove such inconsistencies in the records were a part of the focus of this research. The contributions of this research to the cadastral information field are the establishment of rules and procedures for compiling a topologically structured cadastral index map that is consistent in detail and robust enough to facilitate spatial analysis, including the development of a topologically structured cadastral index map.

Whereas this research does not reject the importance of spatial accuracy in cadastral mapping, the topologically structured approach for creating the cadastral index map is an initial step for countries with limited financial resource to have an inventory of land distribution and to promote better land and resource management. With this model, spatial accuracy of the cadastral index map is not paramount. This approach is not

restricted to geographic region or location, and therefore may be adopted in situations where available data are not accurate enough to apply the other models that have been available until now.

The pilot study proved that by associating descriptive information to the "less accurate" cadastral index map, it is possible to perform analysis on the data and obtain information that is spatially accurate and pertinent to land and resource management. This was shown, for example, by assessing the land rent distribution within the pilot study area.

In conducting this research in Tanzania, certain observations and recommendations were made together with procedures to improve land management activities in Tanzania. These recommendations and procedures can contribute a greatly deal to improved land delivery processes in Tanzania. If adopted, the recommendations and procedures that were developed in this research will greatly improve land management activities in Tanzania.

With regard to Tanzania, this research has looked at the responsibilities of public agencies that deal with land management in Tanzania and showed:

- that record keeping and maintenance, which is the cornerstone of any information system, has been given a low priority in Tanzania.
- that overlapping responsibilities between the city councils and the division of urban development exist.
- multiple agencies have authority to allocate land.

A great contribution of this research to Tanzania is in the design of a process for cadastral index mapping. This research developed procedures for reorganizing land records without the need to initiate a large scale survey, titling, registration compilation from the start. The approach for developing a topologically structured cadastral index map has great potential for developing countries where resources for such large scale initiatives are scarce.

Within the Ministry of Lands Housing and Urban Development, organizational arrangements aimed at faster data processing and approaches for efficient record keeping and maintenance were developed. The objective was achieved by:

- Using existing data.
- Developing a procedure for computerizing existing land records.
- Developing a procedure for isolation of inconsistent data from the land office and the land registry.
- Developing an approach for improving the integrity of existing records.
- Developing a cadastral information model for Tanzania.
- Developing an approach for implementing a cadastral information system as a foundation for an integrated geographic information system for Tanzania.
- Developing procedures for streamlining data processing and facilitating data capture within land management agencies.
- Developing an integrated approach for incorporating new records into the cadastral information system.

- The development of a land parcel identification system for Tanzania, based on the Tanzanian way of describing residential addresses.

A move to a adopt land market policy is a major milestone in the land policy reformation of the Tanzania government. While catering to the expected increase in the registration of land related transactions as a result of the move, computerization of land records became the most appropriate option. It was important to begin with the cadastral records since those records form the core data for a land information management system.

With continued reduction in the cost of computer hardware and software, increases in computer hardware and software capabilities, and the associated benefits of complex analysis to support land administration, many developing countries are considering converting their existing land records from paper format into a computerized Land Information System. Success of implementing a cadastral information system will depend, not only on the design and application, but also on the economic and political climate in which the system operates, the manner and skills with which the potential benefits are presented to the public, and the intangible benefits that the government and the land managers derive from knowing that a decision has been made with the support of the most up-to-date and complete information resources that are available.

Recommendations

Access to an accurate cadastral map is still the objective of many land managers. Whereas the "less accurate" topologically structured cadastral index map provides a

suitable starting point for land managers, an accurate map would have greater potential for spatial analysis in support of land related decision making.

Having successfully developed the cadastral index map by the topologically structured approach, future research could improve the spatial accuracy of the topologically structured cadastral index map. One possible approach is to strengthen localized regions of the map as and when more accurate data become available. Another approach is to distort the more accurate data to fit the map in its current state, and to periodically transform the entire map with a combination of all the available accurate data. These approaches require further investigations, which may involve the development of mathematical models for improving the spatial accuracy of a topologically structured cadastral index map.

This research has focused on the urban lands in Tanzania. It is important that similar research be conducted on the rural lands. As rural land in Tanzania is shared by communities, individual property boundaries in rural communities of Tanzania are not as well defined as properties in the urban areas. Records management in rural areas may require further restructuring of the database.

Despite the falling cost of mass storage media in the computer industry, large volumes of data will be processed with heads-up digitizing and more so, with softcopy photogrammetry. This requires large memory for storage, retrieval, and processing of the data. The need to improve processor speeds, especially for graphic processing is becoming more apparent as application of raster data to mapping gains popularity. Although agencies such as National Aeronautics and Space Administration (NASA) is

conducting research into image compression algorithms, it may be appropriate to develop image processing algorithms and methodologies that are relevant to developing countries and priced within the financial capabilities of such countries. This means developing image processing algorithms that do not require high end computer hardware to operate.

Analysis of land records is only the beginning of the numerous management options that are available for land managers. This research is incomplete unless it is linked with economically feasible and faster ways of determining property boundaries, adjudicating actual ownership, and resolving boundary disputes. During the research, inconsistent records were isolated but no attempt was made to resolve them. Further research could develop methods and guidelines for resolving boundary disputes and adjudicating property ownership. These are problems that exist in many developing countries. The computerized cadastral information system opens up wide areas of research which can be conducted to generate revenue and to ensure an equitable land rent for the community.

This research evolved through an objective to provide the infrastructure for the government of Tanzania to facilitate land related transactions as a result of the move towards a land market policy. In the process, a topologically structured approach to cadastral index has been developed which could benefit developing countries with meager financial resources to manage their land and to keep consistent records.

APPENDIX A-1: TEMPLATES FOR PROCESSING DOCUMENTS AT THE LAND OFFICE

MINISTRY OF LANDS HOUSING AND URBAN DEVELOPMENT
LAND REGISTRY P.O. BOX 1191 DAR ES SALAAM.

REGISTRATION OF CERTIFICATE OF OCCUPANCY

RECEPTION COUNTER

Reference your letter No..... dated ..... with the enclosures, the documents cannot be accepted for failing to submit the following :

☐ Copy of certificate of incorporation.
☐ Consent of the Administrator General.
☐ Evidence of payments of stamp duty/registration fees.
☐ An approved plan of the parcel of land, farm or plot.
☐ Other: .....

You are therefore advised to resubmit the documents together with the items indicated on this list.

.....
for: **REGISTRAR OF TITLES**

DOCUMENT PROCESSING

Reference your letter No..... dated ..... with the enclosures, the documents cannot be registered for the following reasons:

☐ Documents were not sealed/ signed by Commissioner for Lands.
☐ Document(s) not dated.
☐ Ownership not witnessed by Authorized Person.
☐ Area of plot given in deed plan differs from that in schedule as well as Units of Area Used.
☐ Land description not uniform on cover page schedule and in deed plan.
☐ Distance from main road to the farm to be given.
☐ Type of ownership not specified i.e. Tenants in common/Joint Tenants.
☐ Other: .....

Please resubmit the documents after corrections have been made.

.....
for **REGISTRAR OF TITLES**

MINISTRY OF LANDS HOUSING AND URBAN DEVELOPMENT
LAND REGISTRY P.O. BOX 1191 DAR ES SALAAM.

REGISTRATION OF GENERAL DISPOSITION

RECEPTION COUNTER

Reference your letter No..... dated..... with enclosures, your documents cannot be accepted because the following were not submitted:

☐ Duplicate copy of the Documents.
☐ Title Deed.
☐ Capital gains tax clearance certificate.
☐ Land rent and service charge clearance certificate.
☐ Certificate of incorporation.
☐ Certificate of registration of a charge.
☐ Other: .....

Please resubmit the documents together with the item(s) marked on this list.

.....
for **REGISTRAR OF TITLES**

DOCUMENT PROCESSING

Reference your letter No..... dated..... with enclosures, your documents cannot be processed for the following reasons:

☐ Signature/Name of the occupier differs from that in the land register.
☐ Documents not in prescribed form.
☐ Description of land differs from that in the land register.
☐ Underpayment registration fees/stamp duty.
☐ Stamp duty paid after the due date.
☐ Attestation and execution clauses are improper i.e. document not dated or signed.
☐ Ownership not specified i.e. Tenants in common/Joint Tenants.
☐ Other: .....

Please resubmit the documents after the corrections have been made.

.....
for **REGISTRAR OF TITLES**

APPENDIX A-2: TEMPLATES FOR PROCESSING DOCUMENTS AT THE LAND OFFICE

MINISTRY OF LANDS HOUSING AND URBAN DEVELOPMENT
OFFICE OF THE COMMISSIONER FOR LANDS

CERTIFICATE OF OCCUPANCY

RECEPTION COUNTER

Reference your application dated ..... with the enclosures, the documents cannot be accepted for registration because the following were not submitted:

- ☐ Approved survey plan
- ☐ Official letter from the cell/ward leader.
- ☐ Consent by Administrator General.
- ☐ Village/District/Regional committee minutes.
- ☐ Certificate of incorporation to be provided
- ☐ Advice of payment/receipts to be produced
- ☐ Letter of offer to be produced
- ☐ Other.....

You are therefore advised to resubmit the application together with the item(s) indicated on this list.

.....
for **COMMISSIONER FOR LANDS**

DOCUMENT PROCESSING

Reference your application dated ..... with the enclosures, the Certificate cannot be approved due to the following reasons:

- ☐ Letter of offer is invalid
- ☐ Deed plans not valid
- ☐ Certificate not dated
- ☐ Certificate to be signed/sealed by the owner
- ☐ Land description to be uniform on Certificate of Occupancy cover, Schedule and on the Deed Plan
- ☐ Occupier names to be same in all three places in the Certificate of Occupancy
- ☐ Ownership to be witnessed by an authorized person
- ☐ Type of Ownership/Share to be specified e.g. Tenants in common/joint tenancy
- ☐ Improper drafting/typing of Certificate of Occupancy
- ☐ Underpayment of fees
- ☐ Fee for Certificate of Occupancy
- ☐ Registration Fee
- ☐ Survey Fee
- ☐ Deed Plan Preparation Fee
- ☐ Stamp Duty
- ☐ Other .....

Please resubmit the application after corrections have been made.

.....
for **COMMISSIONER FOR LANDS**

MINISTRY OF LANDS HOUSING AND URBAN DEVELOPMENT
OFFICE OF THE COMMISSIONER FOR LANDS

TRANSFER OF OWNERSHIP

RECEPTION COUNTER

Reference your application dated ..... with the enclosures, the documents cannot be accepted for registration because the following were not submitted:

- ☐ Certificate of Occupancy
- ☐ Transfer Deeds
- ☐ Land Rent Clearance Certificate
- ☐ Capital Gains Tax Clearance Certificate.
- ☐ Evidence of payment of fees
- ☐ Registration Fee
- ☐ Letter of Offer.
- ☐ Certificate of Incorporation
- ☐ Application for Consent
- ☐ Valuation Report
- ☐ Consent fee ☐ Stamp duty
- ☐ Other .....

You are therefore advised to resubmit the application together with the item(s) indicated on this list.

.....
for **COMMISSIONER FOR LANDS**

MINISTRY OF LANDS HOUSING AND URBAN DEVELOPMENT
OFFICE OF THE COMMISSIONER FOR LANDS

MORTGAGES

RECEPTION COUNTER

Reference your application dated ..... with the enclosures, the documents cannot be accepted for registration because the following were not submitted:

- ☐ Certificate of Occupancy
- ☐ Cover letter from Bank/Grantor
- ☐ Valuation Report
- ☐ Evidence of payment of fees
- ☐ Consent Fees ☐ Stamp Duty
- ☐ Other.....
- ☐ Application Letter from property owner
- ☐ Mortgage deeds
- ☐ Certificate of incorporation
- ☐ Certificate of Registration of a Charge
- ☐ Registration Fee

You are therefore advised to resubmit the application together with the item(s) indicated on this list.

.....
for **COMMISSIONER FOR LANDS**

MINISTRY OF LANDS HOUSING AND URBAN DEVELOPMENT
OFFICE OF THE COMMISSIONER FOR LANDS

LEASES

RECEPTION COUNTER

Reference your application dated ..... with the enclosures, the documents cannot be accepted for registration because the following were not submitted:

- ☐ Certificate of Occupancy
- ☐ Valuation Report
- ☐ Contract / Agreement / Lease document
- ☐ Consent Fee
- ☐ Registration Fee
- ☐ Land rent Clearance Certificate
- ☐ Letter of Consent
- ☐ Evidence of Payment of Fees
- ☐ Stamp Duty
- ☐ Other.....

You are therefore advised to resubmit the application together with the item(s) indicated on this list.

.....
for **COMMISSIONER FOR LANDS**

APPENDIX B
EVOLUTION OF LAND TENURE POLICIES IN TANZANIA

Over the last hundred years, land policies have been implemented without regard to the rights of the indigenous Tanzanians. The social structures of some communities have been destroyed by moving them away from their economic bases. The customary rights the people have been voided and replaced with western system of tenure. The result has been slow economic development, illegal land markets, conflicts over land, loss of pastoral rights and squatting. In reforming land policies, recognition cannot be given to the customary rights without first knowing what those rights were and the events that led to current situation . This paper looks at how the rights of the indigenous people were taken away by the first European settlers and how post-independent governments have not been able to rectify the mistakes of the past.

Pre-independent Tanzania.

Prior to colonization by the Germans in 1885, the land tenure structure in Tanzania (then Tanganyika) was based on traditional law and the culture of the respective tribes within each community. The components of the communities were clans, families and individuals. The individual, as a member of the group acquired rights in the land that he and his family could clear, cultivate and manage. Whenever the land showed signs of

deterioration, a new piece of land was carved elsewhere in a fallow area while the soil on the old cultivation was allowed to re-nourish itself. Each family could cultivate approximately five acres for subsistence farming. The system worked very well since land was abundant and population was low. Each tribe consisted chiefs, elders and headmen who controlled and allocated land to members of the tribe on a fiduciary basis. Members were prohibited from disposing of land to members of other tribes or families, except with permission from the grantor's family, heirs and sometimes from the chief of the community. People from other tribes could gain membership to another tribe only by marriage. Both paternal and maternal inheritance existed in various parts of Tanganyika.

In 1884, a German explorer and adventurer Dr. Karl Peters was granted large tracts of land by the local chiefs in consideration for trinkets. Soon after, the German ruler, Kaiser, extended Germany's protection to all its territories. The period between 1884 and 1891, was when Europeans were scrambling for land in Africa. The European objective was primarily to exploit the African resources in land and minerals, promote European settlement and promote plantation agriculture in sisal, rubber, cotton, coffee etc. In an effort to obtain protection from the German government, Karl Peters transferred the lands into his company "German East African Company". The Europeans were partitioning the continent and dividing the inhabitants among their spheres of influence. East Africa fell to Britain and Germany. Germany was granted the region that is now Rwanda, Burundi and Tanzania. The people resisted the subjugation by engaging in

bloody wars. In 1905, the Maji-Maji rebellion was crushed by the superior firepower of the Germans. Land alienation and land grabbing thus became the central core of their objectives.

The Imperial Decree of November 26, 1895

In its capacity as the conqueror, and with ultimate interest in land resources, the Germans initiated the tenurial device for declaring all lands "Crown lands" and vesting them in the state. In 1896, the Decree was revised to distinguish between 'ownership' and 'rights of occupation'. Ownership could be proved by documentary evidence whiles Right of Occupation may be exercised by the fact of cultivation and continuous possession. Under the Decree, indigenous lands were unowned and title was vested in the political sovereign (the state), except lands alienated to settlers and evidenced with documentary title. Settler lands became owned lands while indigenous lands were unowned and therefore became state owned by virtue of the decree.

By this Decree the Germans succeeded in merging sovereignty with property. The state therefore not only ruled, but owned land. This gave the Germans absolute power over the indigenous people of German East Africa. The implications of the decree were that only settlers could prove their title and therefore enjoy the attendant security of tenure. Indigenous people were, left with mere rights of occupation. Under the Decree, land could be alienated either by outright sale or by lease. The policy always changed between plantation agriculture which was run by settlers and peasant cultivation. Land was alienated in favor of the settlers. The contract of sale contained certain conditions

which permitted the state to take back the land upon payment of the appropriate part of the purchase price together with compensation for improvements. This was referred to as the 'resumptions clause'. Leases were for definite or indefinite periods. Definite period leases were for a maximum of 99 years. Both methods contained the option to purchase upon fulfillment of development covenants. By the time the Germans left in 1923, about 1.3 million acres had been alienated to immigrants. In densely populated areas, the alienation had already caused local land shortages and resulted in impoverishment.

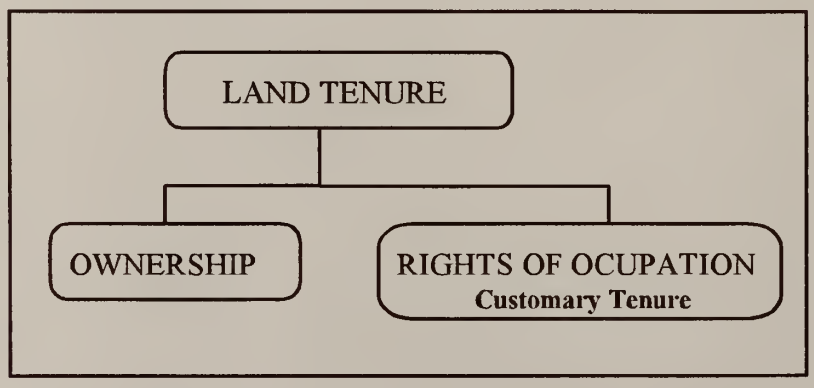


Figure B-1: Effect of 1896 Land Tenure Amendment

The British rule - 1923 to 1961

With the defeat of Germany in World War I. Tanganyika passed into the British while Rwanda and Burundi were governed by Belgium. The British government was made the administrator of Tanganyika as a Trust Territory of the League of Nations. After World War II, the international status of Tanganyika continued under United

Nations agreement. Mandates were set for governing Tanganyika. Articles 6, 7 and 8 of the United Nations Mandate says among other things that :

> "... in reforming the laws relating to the holding and transfer of land and natural resources, the administering authority shall take into consideration native laws and customs and shall respect the rights and safeguard the interests both present and future of the native population. No land or natural resources may be transferred except between natives, save with previous consent of the competent authority. No real rights over native land or natural resources in favor of non-natives may be created except with some consent of a competent authority...."

This provision came to play an important role in shaping the land tenure laws during the British period. Land policy under the British rule was influenced by two conflicting interests ; first of all, the status of Tanzania under international law as a Mandate and a Trust Territory, and secondly, the colonial policy to develop the country as a plantation/peasant economy (as opposed to settler economy) producing essentially cheap agricultural raw materials. It was the need to resolve the conflict between peasant and plantation sectors which underpinned much of the land policy and administrative actions of colonial British.

About 1.2 million acres of land alienated by the Germans were sold as enemy property after the war. Of this, 75% was bought by the British, 20% was bought by Indians, 4.5% was bought by other Europeans and 0.2% was bought by Africans. It was believed that most of the Indians acted as front men for the Germans to repurchase their properties because the Germans were prohibited from buying these properties. By this process, land alienated to the Germans continued to remain in the hands of non-natives. German freeholds were recognized by the the British as English freehold. Leaseholds continued to carry the resumptions clause which was initiated by the Germans. The

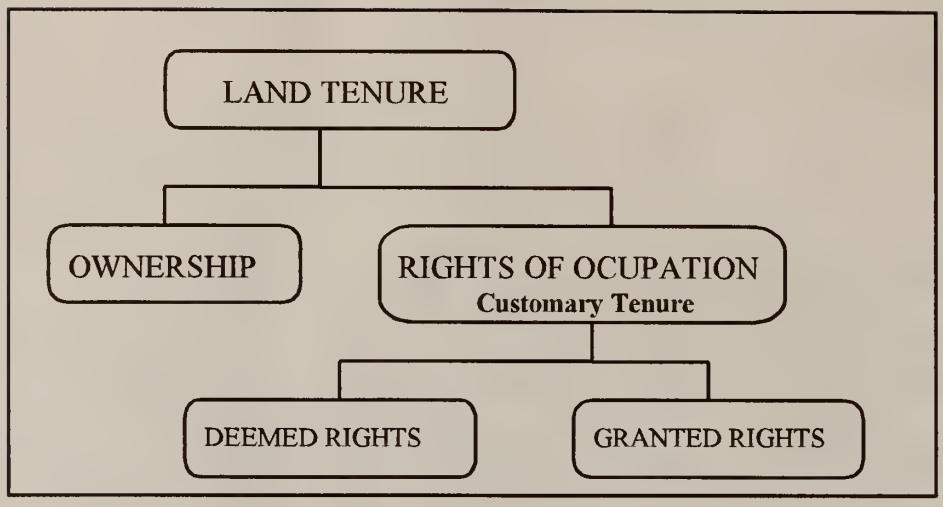


Figure B-2: Tenure Structure after 1928 Amendment

British instituted the Land Tenure Legislation of 1923 which was referred to as the Land Ordnance. The mandates 6, 7 and 8 of the United Nations were recognized only in the preamble. As the preamble was not considered a part of the law, tenure had to be judged on the strength of the Ordinance. The Ordinance was very much a repetition of the German Decree except that the words "Crown lands" and "Empire" had been replaced with "Public lands " and "Governor" respectively

In 1928, the Ordinance was amended to give statutory recognition to customary law titles. The customary law was extended to include the title of a native community lawfully using or occupying land in accordance with native law and custom. Title was vested in a corporate body such as the clan, tribe or community. A customary rights holder has indefinite interest during "good behavior". Since then the customary law title has become "Deemed Rights of Occupancy". Rights of occupancy was granted for a definite period to individuals or families. It was defined as a title to the use and occupation of the land. "Use" was further defined by attaching development conditions

to the grant. Security of tenure depended upon use. The amendment did not specify whether the Deemed Rights of Occupancy enjoyed the same security of tenure as the Granted Rights. This issue was left to the interpretation of the administrators. By virtue of this amendment, customary rights were governed more by administrative policy than by legal stipulations. In two court cases the courts observed that the occupation of land by Africans was merely "permissive" and did not establish any rights against the government. In short, the provisions of the law provided virtually no legal security to customary rights holders. Practically the state could and did alienate indigenous lands to settlers as and when it so desired, depending on its policy and often contrary to the present and future interests of the indigenous population. The Ordinance of 1928 gave the government full powers to deal with land according to whatever administrative powers were adopted at the time. So long as the state desired peasant production, the occupants would be considered to have deemed or permissive rights. When land was needed for the purpose of alienation the governor would withdraw 'consent' and alienate it as a granted right to a settler, presumably against the interests of the inhabitants. Indigenous people were regulated by administrative circulars rather than the subject of guarantee or security in law.

Alienation of Indigenous People

Very few grants were made during the British period. Under the Land Ordinance, the governor was empowered to lease the land either to a native or non-native through grants of occupancy for 99 years. In practice, this power was used almost exclusively to

alienate land to non-natives since the indigenous people occupied the land by virtue of customary law (deemed rights of occupancy). By 1954, only 8 Africans held 2,482 acres of land under long term rights of occupancy. The following year the number fell to 2 Africans holding 136 acres between them. In 1926, the alienation process was extended to the southern part of Tanganyika. The Southern Highlands were opened to white settlers. Within 2 years 222,000 acres of land were alienated from the indigenous inhabitants. In a token effort to recognize the united Nations mandate, and deflect international criticism, an amendment was attached to the Land Ordinance in 1950. It stipulated the consultation of the native authority of the area before any land was disposed. In 1953, an administrative circular made it clear that the obligation to consult the Native authority did not imply an obligation to obtain consent.

Following recommendations by the East African Royal commission in a 1955 report, a government paper entitled “Review of Land Tenure Policy” was issued. The colonial government proposed the introduction of "a form of tenure which is individual, exclusive, secure, unlimited in time, and negotiable" (freehold). The paper briefly reviewed the defects of customary tenure. The most important reason was that the development of customary tenure had been too slow to keep pace with economic advancement.

The then President of the Tanganyika African National Union (TABU), Julius Nyerere, argued against the proposal in an article. Excerpts of the paper are given below :

> "If people are given land to use as their property, then they have a right to sell it. It will not be difficult to predict who, in fifty years time, will be the landlords and who the tenants. In a country such as this, where generally speaking Africans are

> poor and the foreigners are rich, it is quite possible that, within eighty or a hundred years, if the poor African were allowed to sell his land, all the land in Tanganyika would belong to the wealthy immigrants, and the local people would be tenants. But even if there were no rich foreigners in this country, there would emerge rich and clever Tanganyikans. If we allow land to be sold like a robe, within a short period there would be only a few Africans possessing land in Tanganyika and all others would be tenants.
> If two groups emerge - a small group of landlords an a large group of tenants - we would be faced with a problem which has created antagonism among our peoples and led to bloodshed in many countries of the world. Our forefathers saved themselves from danger by refusing to distribute land on freehold basis. "

The government proposals were dropped. Tanganyika went on to become independent in 1961 and changed its name to Tanzania.

Land Tenure After Independence

The new Tanzania government also inherited the conceptual and the major framework on land tenure from the colonial period. The most significant amendment to the Land Ordinance was to replace the term 'Governor' wherever it appeared in the Land Ordinance with the term 'President'. With the President as the head of the executive, the allocation and administration of the land fell under the executive of the government. Some of the major policy changes that have had an explicit impact on land tenure in post-independence Tanzania are to do with freehold, the semi-feudal system (Nyarubanja) and the Landlord Tenant relationship. The freeholds were converted into government leaseholds in 1963. About one million acres of land including some prime properties in urban areas were converted. The leaseholds were for a maximum of 99 years starting form the day of conversion. In 1969, the Conversion of Rights of Occupancy Act was used to convert all leaseholds into Granted Rights of Occupancy. Thus freehold finally

came to rest in one form of statutory tenure - the Rights of Occupancy System - under the Land Ordinance. The semi-feudal system of tenancy existed mainly in the Lake District.

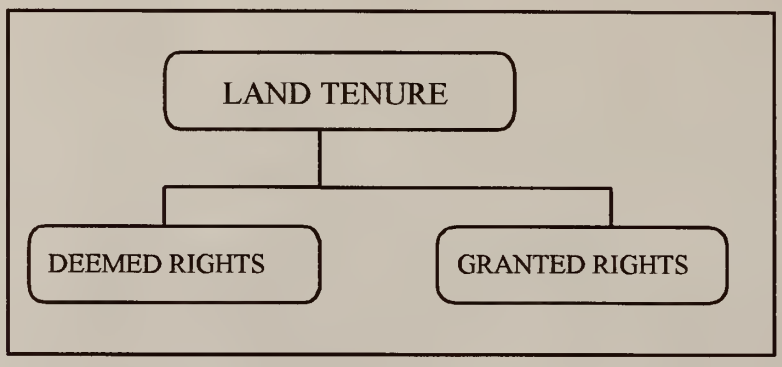


Figure B-3: Land Tenure Structure after 1969 Amendment

The system existed under various names including Nyarubanja. The system operated just like the feudal system of ancient times. A new Act (The customary Leasehold Act of 1968) was enacted. It had wider implications than simply abolishing the feudal type of tenure. The Act sought to enfranchise all types of customary tenancies.

The Arusha Declaration

The Arusha Declaration of 1967 is a significant divide between two major periods. Land tenure policies of the respective periods stand in sharp contrast with each other. Two major attempts at land reform stand out in the pre-Arusha period.

- The village settlement scheme.
- The Range development schemes of the 1960's.

Two other attempts in policy reform which have impacted the land tenure system in the post-Arusha period are:

- The villagization program of 1973-74 (which started as 'operation vijiji' and later came to be known as 'operation Tanzania').
- The granting of village rights of occupancy (village titling) in the late 1980's.

The Pre-Arusha Period

Immediately after independence two reports were crucial in guiding the approaches of the newly independent state to rural development. The Village settlement report was prepared by the International Bank for Reconstruction and Development (IBRD). The report was the basis for a strategy which was adopted in the setting up of the rural Settlement Commission in 1963. It was followed by the Land Tenure (Village settlement) Act of 1965. The second report was for the development of the Pastoral Sector. This report was prepared by the United States Agency for International Development (USAID) in 1964.

The Village settlement Program.

The village settlement program offered what was referred to as Derivative Rights. Occupancy was granted under the Land Ordinance Act to the rural settlement Commission for the purpose of village settlement. The settlement rights were among other things, license for use and occupation, leases, easements way leaves and profits. The village communities had no powers to transfer, exchange, mortgage or change the land held under

settlement right or to grant any lease therein. Derivative rights had little security of tenure. Tenure could be forfeited for any number of reasons including breaches of rules made by the commission on cultivation of land, harvesting or marketing of crops. The settlement schemes were not a great success and were abandoned or closed down.

Pastoral Sector Development (Range Development)

The government envisaged a Statutory Commission to oversee and develop resources in areas which would be selected for Range development by the Minister. The expectations were that Ranch associations would be formed which would be granted rights of occupancy. Subsequently, in range development land where associations held rights of occupancy, the existing customary rights would be extinguished. Again, there was a maze of regulations and bye-laws which controlled the members and the use of the land. Penalties ranged form seizure of stock to ultimate expulsion from the range land. The range development also failed for the same reasons s the settlement scheme.

The Post-Arusha Period

The policy statement of President Nyerere in his pamphlet "Socialism and Rural Development' (1968), formed the basis of the immediate post-Arusha villagization. Living and working together with some form of communal ownership of land was considered the cornerstone of 'Ujamaa' villages. Such villages were to be formed voluntarily by the villages themselves. The role of the government was to encourage and facilitate the process of Ujamaa rather than coerce people into such villages. The government selected

and demarcated the sites. The government also helped to move people into the villages. Between 1969 and 1972, the process was slow and unsatisfactory from the point of view of the ruling party. On November 6, 1973, the President declared that living in the villages was no longer voluntary and that by the end of 1976, the whole rural population should have moved to villages. Thus began the large scale movement into villages. Operation Tanzania was born. The Ujamaa Villages Act was repealed in 1982. Currently it is not known what legislation, if any, govern the villages. It is assumed to be customary law. However, where pre-villagization customary land rights collide with post-villagization allocations, the inclination of the courts have been to uphold the customary rights.

Another amendment to the Local Government Laws (1992), following the multi-party system has made the position of the village chairman an elected office. The Village Assembly consists of all members of age 18 years and over. The Village Council is composed of not less than 15 members and no more than 25 elected members, of whom at least one quarter must be women.

Current Land Tenure Policy in Tanzania

Current land law of Tanzania is essentially what was introduced by the Germans and later incorporated into the Land Ordinance by the British in 1923. A few changes have been made since independence such as the abolition of freehold and landlord/tenant relationships. Under the statute,

- All land is publicly owned and under the control of the state.

- Land rights and titles are based on use
- Commoditization and speculation in land are illegal
- Rights of occupancy - the only recognized tenure - are held in two ways:
    a. Under granted rights of occupancy, which is given, subject to development conditions for up to 99 years.
    b. Deemed rights of occupancy or customary tenure, which subject to use, are held in perpetuity.

According to the statute, cultivated land is either held under granted rights of occupancy, characteristically by a commercial farmer, a corporation or a parastatal using capital intensive technology, or is held under deemed or customary rights by a peasant farmer living in one of Tanzania's village communities.

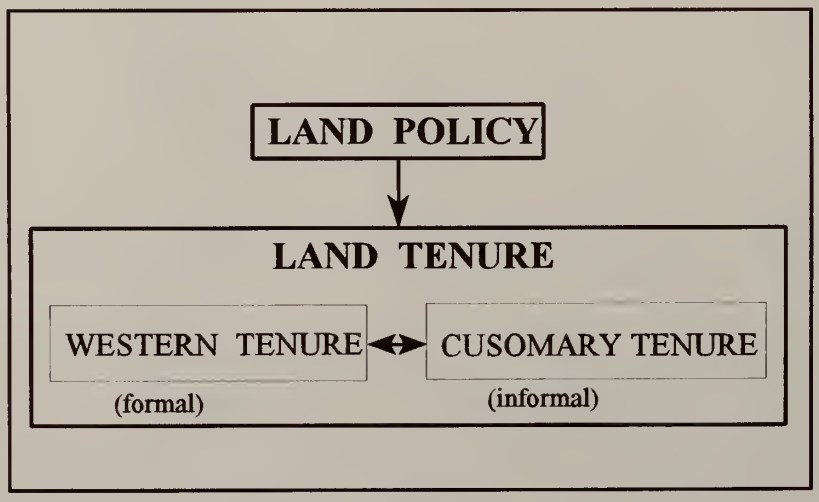


Figure B-4: The Land Policy in a Dilemma

In an effort to administer the land, governments have implemented land policies to guide the framework for land tenure and land administration. As has been demonstrated above, the policies that are implemented by the Tanzanian government have little or no significance to the customary tenure. In most cases the policies are adaptations of the western tenure model. Because the western model is controlled by statutes and regulations, it always gains recognition and hence protection by the law. The majority of the citizens are familiar with the customary tenure and consider the western system an alien principle. The implication is that people with customary tenure fail to register their property. Therefore do not have the security that is offered by the western system. A vast majority of Tanzanians cannot use the land as collateral. The most important problem is that the government has no way of knowing how many acres of land are in private hands or whether the maximum economic benefits are being derived form the land. The solution to an effective land tenure policy and hence efficient land administration in Tanzania lies in the ability to reconcile the two systems of tenure.

The Tanzania government recognizes that current land policies are causing problems in the following areas:

- Land law, administrative process and access to natural resources

Administrative practices of regulating access to land in Tanzania, lacks coherence. Land allocation does not take into adequate account such issues as existing patterns of land use, customary rights, or land value and hence do not ensure justice or foster long-term investment.

- Land use planning.

Land use plans were prepared from aerial photographs with brief visits to the villages concerned. The method took little or no account of location-specific patterns of resource use, individuals' customary rights and common property regimes. In some cases there have been arbitrary denial of access to resource as a result of land use planning.

- Pastoral land use and common property regimes

Since independence large land grants have been made to parastatals for the production of wheat. This has resulted in encroachment in by cultivators on dry season pastures, displacement of herds and people and heightened inter-group conflict and litigation.

- Forest law and tree management

The statutes governing trees do not take into account the complex relationships between people and trees. All trees are classified among protected forests. All protected species are placed under state control. The use of protected trees are regulated through a system of permits and royalties. This process creates poor incentives for local tree and woodland management.

- Land markets

Although illegal, land markets are developing and affecting land under customary as well as under registered tenure. The growth of land markets in the absence of supporting laws and legal institutions is contributing to economic , social and environmental problems that will have long-term consequences on Tanzania.

- Land registration

While the introduction of registration of leasehold title may yield anticipated

benefits such as security and mortgage credit for the small holder in the city, it can have negative effects on the village communities where customary land tenure has prevailed in terms of equity, land use and production. This may be attributable to the government's failure to recognize that customary land rights assure households of access to strategic mix of natural resources and enables the people to pool risks and cope with climatic and economic uncertainties.

Conclusions

Since the early 1980's the need to have a comprehensive land policy that would guide land ownership, leasehold and allocation has been recognized in both private and official circles. The village settlement program (Operation Vijiji) disrupted the customary land tenure system in many rural areas to the extent that it is difficult to determine with certainty the kind of tenure system that is currently operating in some rural communities. Increase in human population have increased the land use requirement of the people. This has resulted in the demand and hence the competition for land, especially around the urban areas. Rapid increase in livestock population has increased the demand for grazing land, especially in Dodoma, Shinyanga and Mwanza regions. Government policies favoring agriculture have resulted in the extension of the agricultural areas into lands which used to be grazing grounds. The effect has been a reduction in the land available to pastoralists especially in Mwanza, Shinyanga Arusha and Shingida regions. Increased movement of livestock and their keepers from traditionally livestock keeping areas like Mwanza, Shinyanga, Tabora and Dodoma regions to other such as Mbeya, Iringa, Morogoro,

Rukwa Ruvuma regions have started to cause land use conflicts in the affected areas. Increased urbanization and high urban growth have increased the requirement for more land for settlements, industries and commerce. The need to preserve valuable agricultural land around the urban centers to meet the food supply has intensified the competition for land in and around urban centers. Development of land markets in an around urban centers is occurring although it is prohibited. There needs to be a legislature to recognize and regulate land markets. Increased awareness among the people of the value of land and property has led to conflicts in urban areas as a result of more people competing for the limited number of lots in the urban centers. The present evolution of customary tenure towards more individualized tenure and development of markets in and around major urban centers. In the older and high agricultural potential areas of Kilimanjaro, Bukoba and Rungwe districts where land is scarce, cash crops such as coffee and tea are grown on individual holdings. This calls for a pragmatic policy and legal framework that supports such process. These problems are rooted in the attempt to import western culture over and above indigenous customs. The solution at the moment lies not only in re-introducing the old system but by modifying the western system to recognize the customary law which existed before the Europeans arrived.

The present land policies pose problems for the intensification of agriculture, equitable access to land and sound natural resource management. Changes have begun to occur in the Tanzanian land policy. The objective for a land policy reform is to ensure the optimal use of the land and its resources without upsetting or endangering the ecological balance of the environment. Other derivative benefits include :-

- Ensuring an equitable distribution of land.
- Recognizing customary rights in land and making the rights secure in law.
- With current trend towards market economy, avoiding the possibility of land being concentrated in the hands of a few individuals or organizations.
- Ensuring rapid socioeconomic development by allocating land to its most productive use
- Streamlining existing land management system and improving the efficiency of land management.
- Implementing sound land information management.
- Protecting land resources from degradation by encouraging development of sustainable resources.

APPENDIX C
OBSERVATIONS AND CONCERNS WITH EXISTING SYSTEM

Urban Development division

	Issue	Problem
1	Base Mapping	Due to the lack of current and up-to-date base maps, town planners often have to prepare the town planners drawings using old base maps. Sometimes the town planners have to update the base maps themselves. This causes delays in the preparation of town planners drawings.

Surveying and Mapping Division

	Issue	Problem
1	Base mapping	Standard sheets are in paper format. They are too old and have not been revised for a long time.
2	Density of survey controls	There are not enough survey controls available in the urban towns. Surveys are done using local origins. At the moment, control densification is done by basing surveys on previous cadastral controls. Newly established controls have to be certified by the director of surveys before they can be used for cadastral surveys. Sometimes approval takes too long to be made.
3	Quality of survey controls	The national controls have been densified at different times using different types of equipment.

4	Manual computation and drafting of field data	Survey processing is done using hand-held calculators, and plotting is done manually. In some regions, e.g., Mbeya, the surveyors use facit machines for survey processing, a time-consuming process.
5	Town planners drawings do not always depict the exact situation on the site.	This is because the base map was not updated before the town planners drawing was prepared. The result is that when the surveyor encounters any discrepancies while demarcating the layout, he has to adjust the sizes of the plots to accommodate the discrepancy. Sometimes it may be existing structures. For this reason, experienced surveyors who can move boundaries in accordance with planning regulations have to be given the task of demarcating the plots and, thereby, limit the number of surveyors who can be assigned the task.
6	The use of old and damaged survey equipment	While theodolite and steel tapes are used in some regions for surveys works, chain and compass surveys are used in other regions. In Songea, for example, all the tapes are broken and there are only one T2 theodolite and two very old Kern instruments. There is no level instrument in Songea.

C-1 Administrative Problems associated with Land Allocation

Urban Development Division

	Problem	Cause and Effect
1	Misidentification of plots	The time between allocation and when the applicant develops the land can be so long that the owner forgets the actual plot that was allocated to him or her. The owner may not feel the need to contact the land officer or the surveyor. So the owner depends on his memory and chooses the plot he thinks is his. The land officer is supposed to show the owners their plots, but because too much time has elapsed since the land officer was first shown the plots by the surveyor, the land officer himself may have forgotten. There are instances where people have built houses either in the road reservation or on another person's plot.
2	Different allocating agencies with inadequate information exchange mechanism	This problem is more prevalent in Dar es Salaam where plots are allocated from the office of the commissioner for lands, the Urban Planning Committee, and by some land officers. The office of the commissioner allocates land for large industrial uses, low-density plots, commercial buildings, and farms larger than 5000 acres. There are no proper means of informing each other when an allocation is made. Attempts are made by the commissioner's office to inform the City Council and vice versa, but due to poor communication system, the notice is received too late. This creates a problem with multiple allocation of the same plot.

3	Lack of infrastructure before allocation	The provision of utilities such as roads, water, and electricity are essential of any land development process. Although a proper road network may be designed by the town planner, unless the roads are made passable, people are not going to use them. Plot owners who are ready to develop their properties may not be familiar with the road reservation. They may use bulldozers to clear a path to their plot and thereby cause damage to other peoples' plots or even remove the boundary markers.
4	Overlapping responsibilities between the planning division and the municipal council in Dar es Salaam	The Local Government Act defines the role of the City Council as the administrators of the city's resources. The Town Planning Act defines the Urban Planning Division in the Ministry of Lands Housing and Urban Development as policy makers. The City Council operates within the policies that are established by the Ministry. The two roles should not be ambiguous in their definitions.
5	Approval of layouts for areas outside the master plan	For areas outside the planned areas in the regions, the Town Planning Act does not indicate that the layouts have to be approved by the director for urban planning. As there are no master plans of such areas with which to check for conformity, there is no reason why the layout should be sent to Dar es Salaam for approval. The important part of the whole process is that the layout should be acceptable to the Urban Development committee. An experienced regional town planner can work with the committee to produce an acceptable layout. This will reduce the process by a considerable amount of time.

Surveying and Mapping Division

	Problem	Cause and Effect
1	Destruction of Boundary markers.	This occurs because the access roads within the plots are not made usable. People usually drive bulldozers along the shortest path to their plots and destroy some boundary markers in the process. This means that the surveyors have to spend time replacing those markers.
	Not enough surveyed lands to meet the public demand for plots	Several reasons may be given for this problem. The most important one being lack of funds to pay compensation. Unavailability of town planner drawings, survey equipment, transportation, and even stationery may be secondary reasons.

Land Development Division

	Problem	Cause and Effect
1	Multiple allocation of the same parcel	Very few duplicate allocations occur deliberately. A major cause of this problem is poor record keeping. In Dar es Salaam, multiple allocations of the same parcel sometimes occurs because the same parcel may have been allocated by the Urban Planning Committee, but the information was not communicated to the commissioner's office on time. Meanwhile the commissioner's office allocated the same parcel to someone else. Poor communication between the two offices is a problem. One agency is not aware of the allocations that have been made by someone else. Sometimes land officers allocate parcels without proper investigation into its ownership.

2	It takes too long for surveyed plots to be allocated.	Because the members of the allocating committee are all holding responsible positions, it is difficult to schedule a meetings. The result is that it takes a long time for allocations to be made once the plots have been surveyed. Some financial incentive is already being given for the members to attend meetings. The indications are that very often, the meetings are not scheduled because there is no money to pay the allowances. People waiting for allocations may be tempted to squat on the plots because the cannot wait any longer.
3	Current methods for determining who gets an allocation leads to corruption	There is generally a desire to allocate on first-come-first-served basis. Because there are always few surveyed plots to be allocated, people who are desperate for plots are tempted to seek favors through superiors of land officers, the influence of politicians, or even try bribing their way to get an allocation. If there are enough surveyed plots to distribute, then there will be no need to use political influence or any other means to obtain an allocation.
4	It takes too long to receive deed plans.	The current procedure is that the survey plan is kept at the Surveys and Mapping office. Every time a request is made for a deed plan, someone has to go and collect the master plan from the survey office and produce the deed plan. Mean-while if another request is received, the request has to wait until the master plan is returned to the surveys office. If there were a hundred plots, this would mean that the plan will travel one hundred times between the survey office and the drafting office, meanwhile people are waiting to process their title. It has been said that people have had to wait 2 years just to obtain a deed plan.

5	Neglecting to pursue the process to obtain title. Failure to submit the advice of payments to the land officer.	In most regions, the Letter of Offer does not request the applicant to submit the advice of payments to the land officer. It may be assumed that payment of the fees constitutes ownership and title. Even if the letter of offer did request the presentation of the receipts to the land officer , it is the responsibility of the Ministry to ensure that certification and title follow so as to ensure record keeping. The Ministry should not leave that responsibility to the applicant.
6	No communication between allocating agencies	Communication is generally poor between offices. In the case where different people are allocating from the same group of parcels, instant communication is essential to avoid giving the same parcel to two or more people.
7	It takes too long to get a certificate approved	People have to personally chase after their certificates to get them approved. Those who rely on the system to work never receive their certificates. The movement of documents from the schedule officers desk to the statistics and to the commissioner's office is too slow, although there aren't too many things that need to be done other than checking the entries.
8	The procedure to send all documents to the commissioner for approval is too cumbersome	All allocations in Tanzania have to be signed by the commissioner for lands. The commissioner for lands has more important responsibilities than just signing certificates. There is the tendency to postpone signing any certificates whenever more important issues need to be dealt with. This could be a bottleneck in the whole allocation process.
9	No means for sending the certificates in the regions to the commissioner's office for processing	The regional offices have no means of transportation and no money to send the certificates through the post. Applicants are often asked to carry the prepared certificates to Dar es Salaam by themselves.
10	Certificates that have been approved remain in the headquarters for too long	This is the same as the issue about getting documents to the headquarters. Transportation is the problem.

11	In Dar es Salaam, documents that have been returned by the registrar of titles due to errors or underpayment of fees remain at the commissioners office for too long	Documents can remain in the office for as long as six months to be sent to the respective land officer for corrections to be made. Because of poor filing methods, documents get misplaced easily. In most cases, the land officer may not even know that the document has been returned for corrections to be made.
12	No way of knowing if an offer has been rejected	There is no feedback if the offer has been rejected. The letter of offer assumes that everyone will accept the offer. For this reason and because there is no proper method for tracking allocations, an offer that has been rejected may never be reallocated.
13	No effective way to verify if the 30-day period for paying the fees has elapsed.	This issue is the same as not knowing if an offer has been rejected.
14	No effective way of knowing if the development conditions are being complied with, e.g., the 3-year period within which the plot must be developed	It is estimated that less than 20 percent of allocations actually get developed. Of this, only about half of them are done within the required period. Technically, the remaining 80 percent can have their certificates revoked and the plots reallocated. Almost everyone knows that the development conditions are not enforced.
15	Revocation of certificates takes too long to process	Revocations can only be recommended. The recommendation must first come from the land officer to the commissioner and to the minister for lands. Every one has to investigate the circumstances and recommend action. According to the law, only the president of Tanganyika can revoke Certificates of Occupancy. Since the president is so busy with national issues, he does not have time to deal with revocations. In the meantime, few comply with the development conditions.

16	It takes too long to locate a document in the open registry	The files in the open registry have grown beyond what the registry was designed for. The documents were supposed to be stored in pigeon holes in a wooden shelf. That was when there were a couple of hundred files to work with. There are currently several thousands of files in the registry. Space has become so critical that files are kept on the floor. Documents get misplaced even in the open registry. There is no control on the movement of files. Land officers can walk into the registry and take any files that they need. Fearing that the file may not be found the next time it is needed, the land officer chooses to keep the file in his or her drawer. Because of this it takes a long time to locate files in the open registry.
17	Lack of stationery for processing certificates	File covers and index cards are always in short supply in all the land offices. Without file covers, it is impossible to process the Certificate of Title. Sometimes applicants are advised to buy their own file covers before their certificates can be processed.

Land Registry

	Problem	Cause and Effect
1	Incorrect or incomplete documents still have to be sent to the registrar for endorsement	According to section 22 of chapter 334 of the laws, the registrar should give reasons for objecting the registration of any title. This condition, however, does not apply to incomplete documents or underpayment of the required fees. The fact that a document is returned to be corrected does not constitute total objection. If documents that contain errors are not sent to the registrar, the time that the document stays at registrar's section can be saved. It is when the documents return to the commissioner's office that the delay really occurs.
2	Lack of stationery for processing documents for registration	This problem is the same as that of the open registry.

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I certify that I have read this study and in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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